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THESIS—SYNOPSIS.

Dated: Jan 13th 2003.

AQUAPOLIS – India's First Aqua-Edutainment Complex.

INTRODUCTION

Mankind, has time immemorial been in the process of exploring the world around them, trying to gain a deeper understanding of the natural resources, their uses and to interpret all the spaces built and those that remain unbuilt around them; man had always struggled to know and reveal the secrets of the world under the water. But anyhow in this battle of study only few succeeded and the rest had to remain on the theoretical database.

An aquapolis provides exciting insight into the secrets of the underwater world. An aquapolis maintains a fragile balanced fascinating those with enquiring minds, as well as dreamers, tourists, nature lovers, experts and children alike; a facility where people can observe and study marine life.

The aquapolis demands an understanding of how to attract and involve people by entertaining them and also how to focus attention, raise awareness and bring reforms in communication through use of the spaces and bringing water to life making dreams come true.

AIM OF THE PROJECT

To design an aquapolis for all category of people of all age group and gender by maintaining the natural environment of the aquatic plants and animals. To attract foreign tourists mainly and also promote weekend family tourism from the metropolitan city of Mumbai. To spread awareness and studies related to oceanography.

OBJECTIVES

Such a proposal of this project in India would not only aim at the conservation of marine life but also works towards the development and at the same time reap benefits from foreign exchange by attracting foreign tourists. India has a vast potential for fishing resources comprising of a long coastline and 30% of the people living on the shore, mans dependence on the sea and the life it nurtures cannot be ignored. It is his own turn to contribute to the symbiotic relationship.

Educating people in this respect and stressing the urgency of conservation would not be better achieved than through entertainment. Thus proposals like this go a long way in educating people through entertainment to make them realize their responsibilities towards other life forms.

SCOPE OF THE PROJECT

India has very few aquatic centers and as such there is a need to boost the same. India has a wide region covered underwater and has coastal areas app.1/3 of it. Hence it has a relation with water and marine life since the beginning so it is necessary to create awareness among the people and provide a superficial platform to interact with the aquatic life. The scope would be to create awareness about marine and aquatic life.

It should also help to generate interest and knowledge among students as well as researchers about the aquatic world. It should act as a tourist, recreational and educational center concerning marine life.

WHY AQUAPOLIS?

The proposal will base itself on the following criteria: -

1) **Ecology**
   It will aim at the conservation of marine life and the ecological balance, which is disrupted by the activities of man. To not only protect the marine flora and fauna from dangers of extinction but also to create an environment conducive for its growth.

2) **Education**
A part of the design program will aim at research and development of formal institution to impart knowledge to students on the science of oceanography. The other part will aim at spreading awareness among he visitors through entertainment so that they have better understanding of the marine life. An aquapolis will be a means through which the conservation needs and duties can be made more popular. A visitor will leave the aquapolis with much more respect for the life it holds.

3) **Entertainment**
Not forgetting the needs of man the aquapolis will propose to be a center of recreation, entertainment and adventure. It should serve as a habitat to revive the spirit of man.

LIST OF CASE STUDIES

DETAILED--

1) Taraporewalla Aquarium, Mumbai.
2) Tokyo Sea Life Park, Japan.
3) Florida Aquarium, Tampa.
4) Sydney Aquarium.
5) National Aquarium, Baltimore.
6) Great Barrier Reef Aquarium, Australia.
7) Marine Mammal Pavilion, Baltimore.
8) Imax Theatre Portvell, Spain.
9) Berlin Aquarium, West Germany.

FOLLOW UP CASE STUDIES—

1) Sea World Florida, Orlando.
2) Sea Life Center, Birmingham.
3) Ibaraki Nature Museum, Japan.

4) Oceans Pavilion, Portugal.
5) Ocean Park, Hong Kong.
6) Singapore Underwater world.
7) Underwater Observatory Marine Park, Israel.
8) Vancouver Aquarium, Canada.
9) Monterey Bay Aquarium, California.

SITE SELECTION—

The site selected is Alibaug on the southern part of Mumbai. The site is close as well as aloof from the hustle bustle of the city life. The site is located among the calm and scenic coastline. The site is also accessible by boat from the Gateway of India from where an 11/2 hour boat ride will take you to a private proposed jetty of the Aquapolis. And you can reach reach the Aquapolis in 2 hours by road from Dadar via Panvel .

METHODOLOGY

1) Synopsis and Design objectives
2) Data collection
3) Site selection and program establishment
4) Sketch alternatives
5) Evolution of design and finalization
6) Detailed design and final report on design

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OCEANS- the origin of existence of life

It is a belief that life on earth, began from the oceans. The oceans are known to have covered the entire space. It took centuries of evolution, to lead to formation of land. Moreover water now covers 2/3 of earth surface and it is to this, that our planet owes its unique position in the universe. The one thing that distinguishes our planet is the existence of life on it. The first form of existence of life is said to have been an aquatic environment in the form of unicellular organisms and lead to the evolution of the most advanced and complicated living being-the MAN.

Oceans are thus the origin of life.

1.

OCEANS-The Masterpiece

God, the almighty creator, of the universe, in his attempt to build a beautiful universe, has given it his most exquisite beautifully interwoven creation- a true masterpiece-the ocean.

In his fantasy, he has painted the canvas of this exquisite piece with infinite shades of intensely peaceful, colours of unknown chemistry, which cool, calm down, and smoothen the senses of man.

He adorned this masterpiece with unimaginably vast and valuable treasures scattering them all around the beds with casual intelligence.

Finally, he sprinkled the canvas, with gold glittering, innumerable species of scores and scores of organisms, which seek their solace and pleasure, only in wandering through the fathoms of this unique masterpiece. These species of fishes and other marine creatures differing from each other in thousands of ways, continuously keep on surprising and astonishing man with their beauty, elegance, power, behavior, sizes and last but not the least their immense contribution to mankind.

Marine life is therefore as I see it, the most beautiful and self content form of life on earth.

OCEANS-A Silent World

It is indeed a seemingly silent world, enshrouded in mystery, intrigue and beauty beyond description. Tropical reefs offer a submarine panorama of colours that seem to vibrate and sparkle but with this spectacular beauty there is great peril. In mystified instances of beauty of form, gracefulness of courage, lavishness of colours seems to go hand in hand with danger and death.

Sea is the only receptacle, for all the prodigious, supernatural things that exist inside it. It is the living infinite. It is rich in all the three kingdoms of nature-minerals, vegetable and animal, the last being well

Represented by groups of zoophytes, classes of mollusks, fish. Fish, is that infinite order of animals, which include more than 13000 species, only $1/10^{th}$ of which live in fresh water.

Sea is a vast reservoir of nature, there lies in supreme tranquility. Life so to speak began in the sea and who knows might end in the sea.

SOME FACTS:

Water covers precisely 71% of the earth combined with greater depths of the oceans. Average depth of the oceans is 3700m. Thus it amounts to provide a living space around 200 times larger than all the terrestrial ecosystems put together. Marine ecosystems provide ecological riches for more than 250000 species of plants and animals.

Below the surface:

Sea covers much of our planet. Hidden beneath the waves lives a rich diversity of plants and animals, appearing to us as bizarre, fantastic and intriguing. The oceans and their habitats represent the last great frontier on the planet. It is significant that we know more about processes on the other planets than our marine ecosystem. Even now startling discoveries have been made. New habitats, such as the hot vents, and huge animals like mega mouth sharks have been found in the last 20 years or so, reminding us how little we know about the planet. Marine biology and oceanography are the sciences that study life beneath the sea in detail.

Knowing the extent of the oceans is not enough. Depth is the second dimension of the oceans. The ocean environment of the deep waters is still quite a mystery to the common man. Strictly speaking three oceans exist-the Atlantic, Indian and pacific- to which the arctic is often added. They cover approximately 70% or 363,000.000sq.km/140,000,000 sq.km of the total surface of the earth. Water levels recorded in the world's oceans have shown an increase of 10-15cm/4-6 in over the past 100 years. Depth (average) is 3,660m. 180m. /600ft. run out from the continents, beyond which the continental slope reaches down the abyssal zone, the largest area, ranging from 2,000-6,00 m/6,500-19,500ft. Only the deep-sea trenches go deeper, the deepest recorded being 11,034m/36201ft.in the Mariana trench of the western pacific in 1957 features deep trenches (off eastern and southwest Asia, and western South America), volcanic belts (western pacific and eastern Indian ocean), and ocean ridges (in the mid Atlantic, eastern pacific, and Indian ocean). Temperature varies on the surface with latitude (-2°c-+29°c); decrease rapidly to 370m/1,200ft, then more slowly to 2,200m/7,200ft; and hardly at all beyond that. Water contains salinity

averages about 3%. Minerals commercially extracted include bromine, magnesium, and potassium, salt;

3.

those potentially recoverable include aluminum, calcium, copper, gold, and manganese, silver. Oceanography includes the study of water movements-currents, waves, tides – and the chemical and physical properties of the seawater. Ideals with the origin and topography of the ocean floor-ocean trenches and ridges formed by plate tectonics, and continental shelves from the submerged portions of the continents.

The surface waters of the oceans are illuminated and heated by the suns rays. They are therefore at least at the lower latitudes, both well lit and warm. Gradually the suns rays are absorbed as they penetrate the ocean and below about 100m the water becomes increasingly dark and cold. Moreover at the surface, the ocean water only has the pressure of the atmosphere above it to stir it. Pressure increases rapidly with depth due to the weight of the water above. The water movement, especially the wave motion, is largely reduced below a few tones of water from the surface.

To live at depths in the ocean, animals may be adapted to the pressure cold and the dark. Plants cannot live there at all due to their dependence on light energy. They are restricted to the top of about 100m of the ocean water. These are some of the facts of the seas, which can only be known theoretically and cannot be experienced practically. Therefore it is necessary for an institute or any building such as the aqua polis.

THE OCEANS AND MAN- An example of symbiosis

In this universe, there exists a strong degree of interdependence between all the living things, and any change in this relationship even in a small scale results in a severe damage to life. These balanced relationships are constantly hampered by natural and manmade events. The sea with its vast marine life should share a symbiotic relationship. Fishes have as much right to exist, as anybody else. If fishes thrive well then they would be of great use to mankind. Man's dependence on sea and the life it nurtures cannot be ignored. Man therefore needs to contribute to its symbiotic relationship. Any activity that he undertakes against the nature's symbiotic relationship will ultimately harm him. Irresponsible and selfish acts like deforestation, damming, coral reef exploitation, living rock collection, water resources mismanagement, over fishing, over dumping of chemical wastes etc. is causing immense damage to aquatic life. Oceans have always

been used as dumping areas for human wastes but as the quantity of waste increases and the land areas for dumping it diminish, the problem is exuberated. Today ocean pollutants include airborne emissions from land (33% by weight of total marine pollution), oil from both shipping and land based sources; toxins from industrial, agricultural, and domestic uses; sewage; sediments from mining; forestry and farming; plastic litter; and radioactive isotopes. Thermal pollution from by cooling water from power plants or other industries is also a problem, killing coral and other temperature sensitive sedentary species.

Properly exploited, the oceans could provide all the food required by humans for years. In seeming contradiction the oceans are desserts in the terms of productivity compared with fertile land areas. These facts do not make a paradox. The oceans can indeed supply all the food we need- but only because of their immensity rather than their fertility. The oceans contain enough protein to free us all, but they will have to be exploited in a less haphazard way than they have been unto now. In the future man cannot afford to be so choosy in what he eats. Man must look for protein in bulk and the oceans are a probable treasure of protein.

RESPECTING THE WATERS:

Despite of its importance, to most of us the aquatic environment represents a total alien world. To man, water means a little more than surfaces and we are unaware of the scores of lives teeming under the calm rhythmic surface. This lack of knowledge, perception is perhaps what breeds a lack of respect of man towards the waters. It is therefore necessary to spread knowledge regarding the ocean among mankind. An aqua polis can always be beneficial in this respect.

OCEANS- A NEW DRUG SOURCE:

The living resources of the sea that are of use to mankind are not limited to the flesh of such animals as fish and shellfish. The seas plant life is another rich resource, seaweed is an important part of the average diet and certain species are regarded as delicacies. Red seaweed yields the important substance known as agar. The gel from this weed is largely used to render texture to a number of manufactured goods such as canned meat, cake icing, sweets and canned foods. Also used as a coating for pills and also in biological and medical labs in cultural media and growth of bacteria and isolated tissues. Seaweed is widely used for alginates used as stabilizers in ice-creams jelly pie fillings foam in beer, to thicken shampoos and fabric dyes, latex rubber, paints, surface coating for paper and many more. Toxins found in marine plants are used as local anesthetic. Research shows that hundreds of marine bacteria, plankton, sponges, plants, shellfish etc contain substances with marked antibiotic properties. Marine plants, it has been found can yield more rugs than land based plants and animals that currently yield half of our pharmaceuticals, rest being synthetic. Clearly the drug industry will not rush to the seas but development is taking place on a constant and regular pace.

MANS INFLUENCE:

Due to manmade modified set of circumstances far too many fishes are endangered. In the long run man, who is dependant on marine life and aesthetic is harmed. Man forms a kind of symbiosis with the livestock he uses as food. It is due to the intervention of man that many life stocks still exist. It results in providing the contradiction in itself- to conserve from man is to protect from man. Though man derives pleasure and recreation from the sea life still he allows hundreds of species to be extinct every year. Lets hope that when the importance of marine life is more universal man will be more truly symbiotic towards the flora and fauna on the earth.

Endangerment of fish is due to man intervention. Some of the human ways leading to problems are as follows:

- Damming dangers: Construction of huge hydro electrical dams can alter habitats beyond recognition. Some river and stream-living species, with particular feeding habits will not be able to adapt to the change and will die off, or they may be driven off when new species are added to the newly formed lake for fishing also the construction of a dam may mean that migrating fishes may no longer be able to swim upriver to spawn. In some parts of the world compromises have been made to avoid the worst effects of damming.

- Deforestation: Deforestation of the rainforest of the world, which was the home of many aquarium fishes, is the main influence on the aquatic environment of the tropics. In brazil huge tracts of these forests have been cut down for short term farming projects financed by the governments a part of the deliberate slash an burn policy, the land is used for a couple of off years until it gets exhausted, then it is left idle and useless and the farming moves to the next area. The increase in the carbon dioxide levels in the atmosphere, said to be partly due to the burning of these rain forest trees, is believed to be the cause of global warming and appearance of abnormal weather conditions throughout the world. Deforestation has very specific effect erosion the water in the rain forest. With the disappearance of the forest a new flood plain is often produced. When water flows through such a land it takes along with it all the nutrients on the surface. As timber collecting and mining has increased in order to meet the demands of the developing
  World, they too have caused massive destruction. Aside effect of these industries is that the soil may be washed down the rivers where it can smother fish habitats, even affecting fishes living in the coral reefs right out in the sea.

- Exploitation of coral reefs: Aquarists are often accused, of exploiting coral reef and pillaging the life there. In fact the productive capacity of the reefs is such that the export of fishes is insignificant, in comparison to the damage created by man in the other areas. Marine parks have now been established in many islands. In these areas collection of fish is forbidden and the studies

to assess the levels of harvesting that can be sustained without harming the reef are underway. Reef fishes are regarded as precious resources, encourage tourists and boost international trade. The use of living rock for the aquaria has caused concern over the recent years and embargoes are now placed in some countries. Much of this rock, which is colonized by marine animals, has been taken from these reefs, causing serious damage. This human solution has prompted collectors to seed areas, between the reef and the shore with suitable rock, the nature can be gathered.

- Mining of reefs: In several parts of the Pacific Ocean, mostly off Sri Lanka and around the island of Bali, huge areas of corals have been removed by mining to provide stone for roads and buildings and lime for making cement. The removal of a reef not only destroys an ecosystem; it also leaves the coastline exposed to the full fury of the sea. The government has now stopped many reef mining operations as a part of a scheme to protect the marine environment and prevent coastal erosion.

- Tourism influence: The growth of tourism over the last 30 years has caused other problems. The construction of sea-front hotels, harbors and marinas often involves the destruction of whole sections of a reef. The popularity of sailing and boating in topical sunlight also causes problems out in the sea. Leisure time sailors tend to see reefs as underwater obstructions to be hacked out of the way, and an anchor dropped anywhere can smash years of growth to splinters in an instance. The beauty of corals is best viewed as underwater. Sadly underwater tourists are often tempted to take a small piece as a memento.

This activity not only spoils the beauty of the ref it also kills it slowly. Thousands of tones of the most attractive varieties of coral reef are cultivated and sold as souvenirs, or carved into ornaments or jewellery. Bit by bit the reefs are disappearing in front of the respected authorities. In some areas the black coral is almost extinct. Animals that live on the reefs create many of the most valuable sea shells, perfect specimen are found by diving for live animals. Out of 100, 99 are thrown off because their shells are not perfect enough.

If this commercial harvesting continues some species of coral, shellfish and fish are bound to disappear. This will create a series of small holes in the food chain and other relationships, which

bind the coral ecosystem together. In the Caribbean where the destructive effects of tourism have been the greatest the Bonaire Marine Park aims to encourage both tourism and research. Two areas have been set-aside as reserves where diving is prohibited and scientists can work. In the rest of the park, underwater sightseeing is encouraged, and the scientists must put up with a certain amount of accidental damage caused by inexperienced divers. The encouraging example has shown that tourism and conservation can exist side by side.

- FISH TRADE: Millions of fish are also taken each year for the international aquarium trade, many of which are taken from the coral reefs. In some Asian countries, professional fishnappers use poison to dope all the fishes in the vicinity and then scoop up the ones required leaving the rest to be eaten up by birds. If the commercial harvesting of exotic species continues, some species of coral, shellfish and fish are bound to disappear. This will create small loopholes in the food chain and other relationships, which bind the coral ecosystem together.

POLLUTANTS IN THE OCEAN:

POLLUTANT	NATURAL SOURCES	HUMAN SOURCES
Hydrocarbons	seeps, rivers, volcanoes	transportation, production

	Atmosphere, bacteria	aerosols
Heavy Metals and municipal	volcanoes, river sediments	industrial
	Weathering of rocks	effluents
Nutrients effluent	river upwelling	municipal
agricultural fertilizers	Atmospheric, bacterial	
	Decomposition	
Synthetic chemical manufacturing, transportation	rivers upwelling	
agricultural fertilizers	Atmospheric, bacterial	
	Decomposition	

By acquiescing is an act that can disrupt and destroy the delicate ecological balance. Who among us is not diminished as humans? Humans are all seriously deploying the atmosphere everywhere including the vast ocean habitats.

10.

CONSERVATION OF NATURAL MARINE HERITAGE

In a country like India with a long coastline and 30% of the people living on the shore mans dependence on the sea and the life it nurtures cannot be ignored. It is his own turn to contribute to the symbiotic relationship. Because of any activity that man indulges against the balance of the ecological symbiotic cycle will harm none but him.

Here in these circumstances, efforts to conserve the natural marine heritage propose to bridge the gap. With notorious activities of over fishing and dumping chemical wastes into the sea, concerns to conserve marine life to materialize in the form of extensive conservation schemes.

1. Aquariums
2. Marine life parks
3. Oceanarium
4. Aquapolis

AQUARIUM:

The word aquarium has a Latin base. The aquarium is artificially constructed and seems to have been invented by Gosse, who needed a term to describe a vessel in which aquatic organisms could be kept alive for observation. A traditionally public aquarium consists essentially of a building containing of a number of separate tanks in which aquatic plants and animals are made available to the public for observation at close quarters. Because of the separate tanks it is easy to segregate the species and provide labels for their identification. It is also easy to provide varied settings appropriate to the species displayed.
Many people visit the aquarium only for entertainment or curiosity and leave with a fund of knowledge they had never expected. An aquarium can enable people to think of aquatic life more than just fish or chip.

SEA-LIFE PARK OR MARINE-LIFE PARK:

The marine- life park consists of a natural ecosystem conserved in its natural form with no artificial ingredients. The aesthetic and scientific aspects of marine life will easily become noticeable. There are certain pockets, which show the presence of luxuriant growth and unique

flora and fauna. These constitute of an important part of natural heritage and provide opportunities for recreation education and research.

A marine life park needs unpolluted area with clear and calm water with a transparency of 7 ft. aquatic flora and fauna have to be observed in their natural form. (By means of boats with a transparent acrylic bottom or under water observation tower). A marine life park is equivalent to a wild life sanctuary.
A marine life park may have a number of species of marine biota but since the species are not captivated the probability of viewing all the species, or for that matter only some species is less. A person has to take a chance.

12.

OCEANARIUM:

An oceanarium is an aquarium on a bigger scale. It is more often more spectacular and dynamic and does not provide the same facilities for intimate study. An oceanarium consists of

large giant tanks with different species of huge fishes, which are more spectacular. It may consist of whale pools and dolphinarium for entertainment purpose. Touch tanks may be provided for special study purpose where the students or learners would like to touch the fishes and study more about them.

Considering all these factors, a good combination of an aquarium and an oceanarium would be the best to suite the purpose of conservation and study, harmoniously. The proposal spans the realism of space, the atmosphere, the ocean, the sea floor, and to deep within the area as efforts are made to understand the structure of the earth.

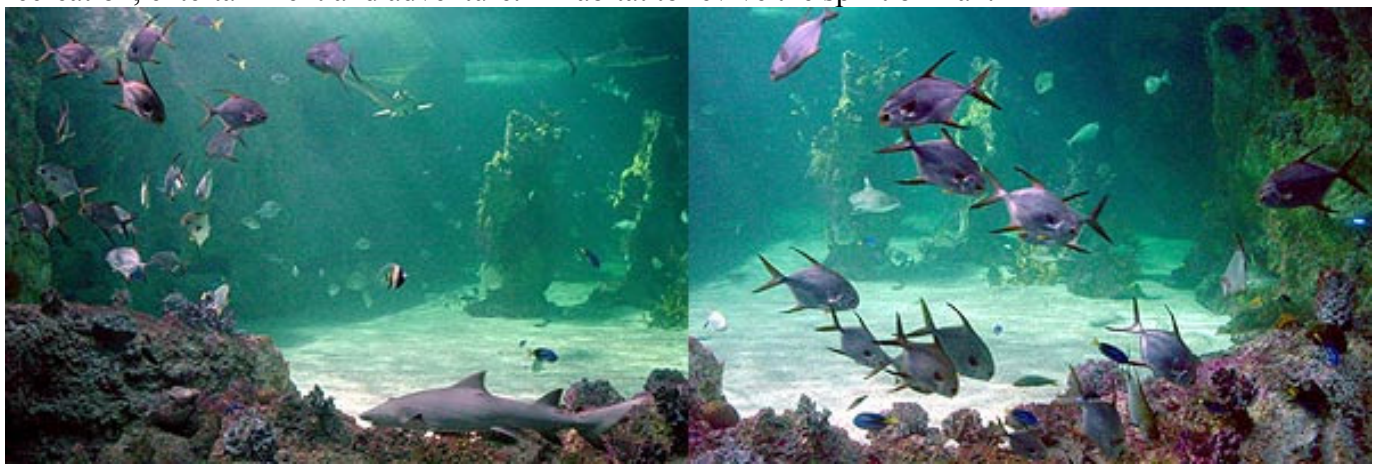
13.

The proposal of the oceanarium will base itself on the following criteria:

1. Ecology: It will aim at the conservation of marine life and the ecological balance, which is disrupted by the activities of man. To not only protect the marine flora and fauna from dangers of extinction but also to create an environment conducive for its growth

2. Education: A part of the program will aim at research and development of formal institution to impart knowledge to students on the science of oceanography. The other part will aim at spreading awareness among the visitors through entertainment so that they have better understanding of marine life. An oceanarium will be a means through which the conservation needs and duties can be made more popular. A visitor will leave the oceanarium with much more respect for the life it holds.

3. Entertainment: Not forgetting the needs of man the oceanarium will propose to be a center of recreation, entertainment and adventure. A habitat to revive the spirit of man.



SCOPE OF THE PROJECT:

An oceanarium is a project completely devoted to the exhibition of aquatic plants and animals from the various strata of the ocean as well as from other sources of water in an interesting and informative manner with the motives of entertaining and educating the visitors.

The project would help us better our knowledge regarding the seas and about the sea life. In captivity the behavior of the animals can be studied without going out in the natural environment.

The research would go hand in hand with this project. This is especially vital in today's world where a number of wild aquatic animals are becoming extinct. It is necessary to make a study of their behavior patterns to further our knowledge about their life.

A layman's knowledge of the seas is restricted to fish food and beaches. The project would serve the dual purpose of making the layman aware that diverse and multifarious life exists in the seas and thereby making a point of conservation and preservation of the seas. Such a purpose along with serving a humane purpose would also be a major tourist attraction in the future.

Human minds have always been fascinated by this somniferous entity. The vastness, dynamic potentialities and the great depths have remained an aura of mystery to them. Even today man is perpetually exploring and discovering different facts of the ocean.

Water being a hostile environment for terrestrial creatures, exploitation by a layman is restricted to cruises and beaches and still further for some fortunate few an exploration of the water by scuba diving expeditions. Again, oceans differ from place to place even within a few reels of street with respect to geomorphology, ecology and water characteristics. Thus there is a vast need for a complex known as aqua polis to display life forms on a greater scale and enabling the layman in understanding the diverse nature of the oceans.

'JAWS', '20 THOUSAND LEAGUES UNDER THE SEA','THE DEEP'-HOLLYWOODS attempts to scare us out of the waters.

This project invites us to jump back in… and learn the truth about sharks, piranhas, octopuses, eels and stingrays.

WATER-THE FORMS AND FACES

Water is a chemical combination of O2 and H2, is odorless and tasteless liquid. Plants consist up to 95% of water and other animals up to 60-70%. It is natures most widely used means of solution and transport.

Without water there would be no life. Water is in a state of constant metamorphosis and circulation. Over the sea it evaporates in the warmth of the sun, rises and is carried out into the land by means of wind and falls back into the land in the form of rain and snow. Some of it evaporates again and the rest flows into the seas by means of rivers and lakes. Water has no form. It is shapeless and soft. It can appear as drops, a puddle, pool or lake. It can stand, flow plunge and also rise. It can be poured into a glass or into a pool. Water is wet. It can be cold, warm, frozen or boiling. For man it has two aspects- positive and negative.

He can drink it, wash in it, swim in it or even drown in it. It puts out fires, destroys mountains, breaks down rocks and even makes wells, ponds, cascades, fountains and waterfalls it destroys walls when it penetrates them. The surface of water can be used as a road. Fishes can be caught from its depths. It can be used to irrigate fields and it also destroys fields by means of floods.

Invisible forces are also present in water and they can also be put to work. In religious mythology water has the aspect of life and death. Source of life, holy water, baptismal water, the river of the dead, which marks the baleens of the beyond. In psychology, water means subconscious. The ego becomes a deep lake, above whose surface consciousness towers, towers as a tiny island. Water is a basic perquisite for any settlement. Rivers are the little veins on the earth's skin. But this blood flows open into the air and light.

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RIVERS

The rivers glide by still and silent. The surface is almost smooth, with just a gentle wave rising at the intermediate spaces. A slight swirl and the surface are calm again. The images remain in some places, the water flows through them. Gravel rock and twining water plants are seen as if under a sheet of glass. The river is slowly flows over the earth's surface over a distance, an unknown but low-lying goal. The trees are the only ones who know the secret of the water from the depths.

18.

LAKES

Lakes in the landscaper's eyes are traditional images to the inner world of nature. There are metaphysics of nature a virtual connection. The beauty of the lake derives partly from its existence and partly from its reflecting changes. The surface of the lake becomes an ideal image this way. Water is the greatest and the most powerful canvas of the landscapers' mood. Finally water as the first principle element of nature life as everything on earth derives from it and the infinity of the sky reflecting from it. It draws us into double bonds, as it stimulates and enlivens our feelings, living and active, foaming and gushing on its bright or dark mirror awakes in us a feeling of

endless longing. Architecture is made up of water and ice crystals, constantly changing and moving as result of thermal circulation and drops in the. temperature of air.

19.

Although water makes up only a small part of the earth, it covers 3/4th of the surface. Coast, beaches sharp shallow sandy rocky pebbly covered with single edged with gigantic palm like paradise or bordered with iceberg. For millions of years, wave has been beating against rocky walls, cracking on sandy beaches, breaking and then swallowed.

Water does not only circulate through bodies, plants, and through heaven and earth, it also circulates through cities and industries, through pipes and sewers, through nuclear power stations and chemical wastes, through purification plants and municipal baths, through car washes and sprinklers. It is present in every resistance. Turn on the tap and you become a part of the system.

Everyone uses it, boils and drinks it recreating the circulation of water is an important subject of new land usage architecture.

20.

WATER AND HUMAN RELATIONSHIPS

Water is an element whose qualities have entranced and inspired culture for millennia. Drawing on, its spiritual and purifying power, builders throughout the ages have used waters elusive and reflective properties to create places of magical beauty where mind, heart and body concentrate in tranquility. The waterside buildings capture and enhance the life in many extraordinary ways.

Water exercises a magnetic spell. Its spell is constantly changing, calm at one moment and still, reflecting the sky, sun and the waterside trees and plants, like a mirror, the next ruffled by the wind. Reeds growing near, the margins bend and sway, while the small brightly colored fish dart among the underwater vegetation, providing a living interest. Not only there is a movement, there is a sound of many water lapping and splashing over the rocks and tumbling over, waterfall of the poolside reeds and grasses rustling in the breeze but above all, of the birds and other creatures lured into the area because of the presence of water. There is also a certain fascination about the plants, which cannot be grown anywhere else near water.

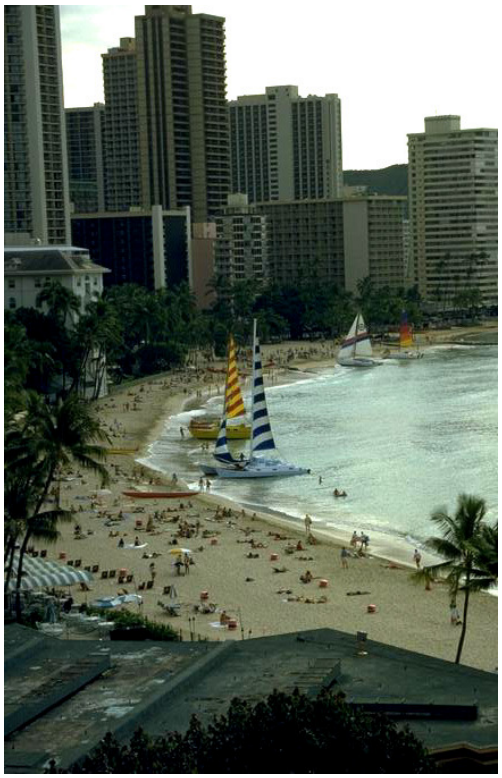
A scene including water is known to move the heart of man. The main elements, which cause this emotional reaction, are the substantial nature of water and the interrelationship between water and space. Another characteristic of water is that it links two different spaces, unites several components into one, divides a single space into sections- the interrelationship between water and space. In order to profoundly affect people and cause deep impression in their mind it is essential to create, a design through which viewer can visualize these elements. That means it is necessary to manipulate things, such that people and water come in direct contact. A relationship of this kind may be called immediacy. Water inspires people. Water would give immense pleasure if it flowed into the sound of music. When colorful lamps, water jumps, leaps and dances light it as if live and leads people into a world of fantasy. Musical water is now a means of enhancement of the urban environment.

A preference for a coastal setting represents a psychological connection to Planet Ocean made up of actual oceans, seas, rivers, ice and ground water. Every drop of seawater reminds us that it is part of an ongoing cycle of global change, belonging to a specific time and space.

Islands also cast a magic spell on our imagination as they separate us from the rest of the world, create their own worlds in a seemingly infinite oceans, because of their isolation, islands foster habits and customs different from the neighboring landmasses.

The framing of views is also equally important. Whether lunette or ovals, multi paned or sheer windows can transform mere vistas into completely and carefully choreographed masterpiece.

Blinds can also add mystery. Windows reflect water views indoors in the form of transparent glimmer or draw dancing refractions.



22.

HISTORY OF FISHES

Fishes have truly an ancient lineage, one stretching to more than 400 million years. By way of comparison, whales, the masters of the great oceans as they seem to us, have existed for just 55 million years. Yet though there is this long history of fishes we know surprisingly very little about them. Their domain the aquatic regions of the world comprising the whole 70% of the earth

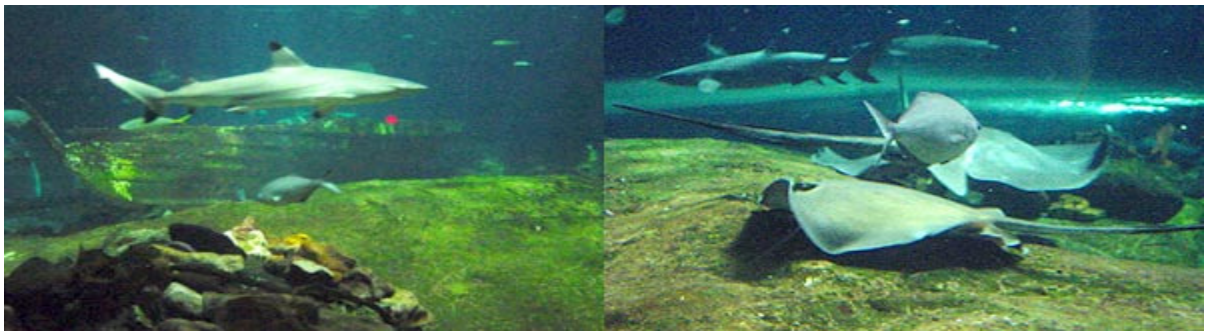
surface, became available to serious scientific study only about 50 years ago. The breakthrough came with the invention of the scuba diving instruments. This gave the ichthyologists an opportunity to observe relatively unhindered, the natural behavior of the many species of fishes. From the available archeological evidence, we are aware that fishes have been important as a food source since prehistoric times to the coastal tribes and the people living near the seacoast. Shallow swimming fishes were taken with rudimentary spears and clubs deeper swimming was taken with nets. But it was not until ancient Egyptian times that we know of fishes kept and bred not only as ready supply of food but, more importantly from an aquarists point of view, because of their ornamental use.

23.

As a food source the Egyptians preferred rearing the Tilapia species, while for their beauty they kept mormyrids, which were regarded as sacred animals. There is tenuous evidence that the gold fish, selectively bred carp, date back to the Tang Dynasty of China, (AD 618-AD907), but stronger evidence also exists for their presence in China during the sung dynasty (AD 970-AD1278).

The introduction of the gold fish in Europe was delayed, however and they did not reach England till the end of the 17th century. But within the next hundred years they became widespread in ornamental ponds and lakes. Back in Europe in the mid 19th century fish keeping was becoming a serious affair. In 1853 in the London Zoological Society established a public aquarium with the assistance of Philip Gosse, who spent some time developing his concept of the balanced aquarium, one which there were aquatic plants and animals.

Gosses' concept of a balanced aquarium has become crucial in the development of fish keeping, as we presently know it. Many aquariums were attempted tanks that housed fishes caught locally in the rivers and found in the rock pools. There were thus tanks loosely related to a single habitat. With the advent of air travel, exotic fishes from all over the world became available and with them came the concept of community aquarium. In these, the mixed populations from widely different habitats were introduced together; the only thing these fishes had in common, apart from tolerating the same general conditions of the water, was an easy going and indulgent nature.



THE CLASSIFICATION OF FISHES

1. FRESH WATER FISH GROUPS

Fishes can be divided into certain groups, each one made up of various genera that are useful categories for the aquarists. On looking at most of the fresh water fishes, there are simple external characteristics that allow you to make a tentative identification of the fishes group. These include body shape, fins, mouth and teeth, coloration, plus other specialized traits. Based on these features, the majority of the fresh water fishes can be divided into seven major types:

- Catfish:

  These fishes have been found to have around eight barbells round the mouth; sometimes these are long and whiskery. Often a ray less adipose fin sits behind the dorsal fin. The dorsal fin may have very strong fin rays, which are sometimes serrated. The coloration might be quite dull and some species have no scales.

- Loaches:

  Similar in some ways to a catfish, loaches have no adipose fin. They are generally small fishes: may have long snake like bodies. They have six small barbells around the mouth. The dorsal fin is often close to the middle part of the body, which may be brightly colored.

- Characins:

  These have true fish shaped body, scaled and often with a metallic coloration: some are fluorescent. The fins may be colored and there is a small adipose fin. The males of some of the spaces in this group also have a tiny hook on their anal fin. The males of some of the species also have a tiny hook in their anal fin. The mouth is always terminal and contains teeth the majority of the fish in this group originate in South America.

- Barbs and rasboras:

  Members of this group are classically fish shaped and are obviously scaled and often brightly colored. The dorsal fin is often setback on the body and there is often no adipose skin. Must have barbells, although these are inconspicuous. The mouth, which is terminal, has no teeth.

- Live bearing and egg laying tooth carps:

  Usually less than 2 inches long, these have a flat-topped head with small, upward facing mouth. The dorsal fin is usually set back on the body.

- Cichlids:

  Often brightly colored and with bands and bars as markings, these fishes have a terminal mouth. Many of them also have a large dorsal fin and deep body.

- Labyrinth fishes:

  Externally similar to the cichlids: the anal fin of Asiatic species trails to the level of the dorsal fin or beyond it. In the African species this feature is not as prominent instead look for a serrated edge to the top of the gill cover. These labyrinth species often have marbled body markings.

2. COMMON MARINE FISHES

Since there are many more marine species it is not easy to classify them using the same kind of distinctions as are for the fresh water fishes, but basic visual descriptions can be given for ten groups that are most commonly seen in the aquaria.

- Surgeon and tangs:

  These are deep-bodied fishes with compressed sides and a high profile. They have sharp spines protruding from the neck of the tail. These spines can be erected or can be left flat.

- Angelfish and butterfly fish:

  This group is similar to the surgeons and the tangs but there are no spines on the caudal peduncle, although angelfish have a spine protruding from their lower gill cover. The color and patterns of these species is specially designed for camouflage or species recognition.

- Cardinal fish:

  There are two obvious erect dorsal fins and large mouth. Being nocturnal they have large eyes.

- Squirrelfish:

  They form another group with large eyes, as they are nocturnal. The dorsal fin has a strongly rayed front section and a high standing back section with softer eyes.

School of fishes:

This is an important aspect, which regulates the designing aspect to size and functioning of the tanks. If there are fishes with distinct territorial habits which lead to a solitary life attract their fellows, these are fishes whose gregarious are developed right from the start. Schools, which are the expression of this gregarious existence, involve in some species a considerable number of individuals. Therefore it is essential to know which of these fishes have gregarious so that the tank is in accordance with it. A school of fish is not a casual notion, but a collection of initials, which observe strict rules in which instinct and sensory perception of the fishes play an important part. Experiments on the behavior of young fishes have confirmed that the schooling is innate and is perfected in the first stage of life. A fish, which becomes isolated from the school when young, has difficulty in reinserting itself. Taking about the design the design will not have to cater to fish but to a particular group of fishes, which act as one.

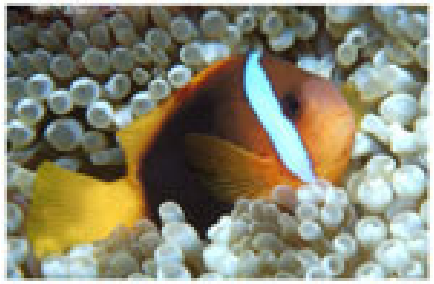
28.

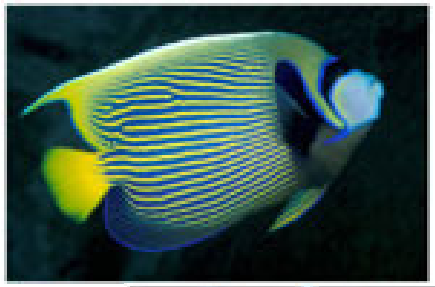
The importance of color

If you watch a fish, it is easy to distinguish its belly below not by shape or the position of its fin but by its color. The majority of the fishes have predominantly light colors on the ventral parts. This is usually more obvious in pelagic fishes, which enjoy a living in a concealing system that uses the effect of light that falls on the bodies of the fish from above.

If the light distribution was normal, the back would be light and the belly would be dark. In such a case the fish would be seen even in a way off. Obviously they had lighter hues on their belly, so that they have uniform color when illuminated from above.

This kind of coloration is called counter shading.





Mimicry and defense

Some species of fishes have a considerable case to adapt color to their environment. The color can vary in a very simple way. It is contained in the chromatophores, which are the cells under the skin and the change in the stimuli that the animal receives. Expanding the pigments in all the chromatophores modifies such intensity or restricting to a small area, if the pigment is expanded, the color becomes visible. Many colors are obtained by varying the inclination of the crystal of guanine in special color cells called bridocytes. This act as prisms, breaking the light into colors of the rainbow. An experiment to control the advantages of such color adaptations were carried out with gambesons that had been kept in light and dark colored tanks. The two predators were kept in tanks of opposite colors to that assumed, together to an equal number of gambesons of the same color as the tank. Then the two predators were put into the tanks and soon they began to feed on the gambesons. The surviving gambesons, which were of the same color as that of the bottom of the tank soon outnumbered the others, remaining in the ratio of 3:1. The advantage of their coloring is thus obvious necessitating the design of the tang in relevance of the fishes, which show such properties.

30.

Symbiosis and survival

One way of surviving in a hostile environment is to seek protection near another huge animal or one endowed with an understanding means of defense. Usually the protection is reciprocated with services of various kinds as in the case we have already seen of cleaner fish, labroids. One of the best symbioses between fishes and vertebrates is have the apivorous or clown fishes, with large tropical anemones, to whose usually fatal stings they are immense.

Fishes and sound

From an acoustic point of view, water has outstanding characteristics such as a better diffusion of sounds and noise than in air. Fishes are able to utilize this property of water to catch the vibrations emitted by the other fishes and to distinguish predators from harmless fishes. A jack listening to the noise made by a shoal of small fishes, feeding normally will get agitated and go towards the noise. A school at rest makes very little noise, but if suddenly disturbed, it makes continuously loud noise as it begins to move. Having reached a cruising speed, the noise becomes rhythmic, which suggests that it may be made by the mechanism of swimming.

Movement in water

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Resistance in the medium conditions movement in a liquid in the first place, which is 800 times greater than air. Anyone who has tried to run in the water or to move an object in a liquid knows how tiring it is. The streamlined shape of the fish and their way of moving allows maximum efficiency with minimum efforts, moreover the solution of the problem of movement are bound up with lives and the habits of different species.

The movement of fishes in water

All the fishes can move in water but do all move in the same manner. Their shape is important for swimming purpose but their internal structure is even more important. It is this that limits them to a particular movement. Two important observations can be made; the main part of the movement is not carried out by the fins but by the latter part of the body. The movement is a result of a series of rhythmic flexures in the body. Analyzing these flexures further we see that they are made by waves running along the body. The extent of these waves increases little by little until they reach as far as the head and the tail. The motor that makes them swim in the series of muscular segments on either side of the ventral column. Fish also need to maneuver in their surroundings to be able to perform turns and stops and to make certain movements in the reverse. Their fins carry out this.

Coloration and fish

If one observes the scales of a colored fish, it will be seen that for example the green color is made by a number of blue and yellow dots. The blackish brown, yellow and red pageantry colors of the fishes are distributed among the thousands of color cells or chromatophores. When for instance, the black figment granules in the chromatophores are released the cells will be black, but when these granules are gathered into a tiny pint of the cell will not appear black. By this kind of mechanisms the color can be made to change from time to time.

Many bottom living fishes, such as flat fishes, camouflage themselves by taking the color and the pattern of the substrate. The color change is under the control of the hormones and the nervous system. Almost all the fishes that live in the upper water layers have pale silvery sides to their body. This color depends on the reflection of light from the colorless microscopic crystals that are deposited in the chromatophores of the dermis. These crystals contain guanine a by-product of metabolism. Deep-sea fishes are dark while those living among the seaweeds have grown green or brown protective coloration. Finally many attain nuptial coloration during the breeding period and this may serve to attract a partner or to drive away rivals.

CORAL REEFS

DEEP IN THE WAVES THERE LIES A CORAL GRAVE
WHERE THE PURPLE MULLET AND THE GOLDFISH RAVE
WHERE THE SEAFLOWERS SPREADS ITS LEAVES OF BLUE
THAT NEVER ARE BATHED IN THE MORNING DEW
……..J.G.PEREIVAL.

Coral reef is an organically constructed wave resistant rock structure created by carbonate secreting animals and plants. The bio-diversity and tropical dynamics of a reef ecosystem are so unique and spectacular that they require serious consideration. These are intimately connected complementary communities in which every function required to create, maintain, and control a self- contained ecosystem in the shallows, virtually barren tropical seas is satisfied by some organism or the other, but it is not critical which organism fulfils which role. Thus coral reefs are almost infinitely variable, complete self-contained, self-supporting ecosystems. Corals are animals with a rather simple anatomical design that belongs to phylum conidia. Coral animals themselves consist of sac like polyps, body of living organism that are housed for protection in a rigid calcium-carbonate exoskeleton called as corallites.

34.

Coral tissue reveals numerous unicellular plants called zooxanthellae. Coral animals and zooxanthellae benefit mutually by from association-mutualism. Most important they create their own structural form and as such control their own axes to light, oceanic water input and output. Most people think of coral reefs in terms of corals and fishes, these two groups are perhaps the most eyes catching. However coral reefs are no more animal dominated than any other ecosystem with non-limiting supplies of light and water. The plants, which provide the basic energy trapping and food synthesizing capability of the ecosystem, are on the whole unspectacular and diminutive. Many of them are symbiotic and contain animal tissue. They have very fast growth rates and hence fast food production rates. The structure fondly referred to, as coral reefs owes its very existence to the reef plants. Most of the reef corals are found to have 50% of calcium carbonate originally deposited by the corals. The other 50% are calcium carbonate mostly of the algal origin, with lesser amounts derived from foraminifer-very small single celled organisms and mollusks. The corals make the stone and gravel of the reef while the algae make most for the sand and the cement. Most coral reefs occur in areas of the oceans with extremely low soluble nutrient levels.

35.

Tropic pyramid of a coral reef

Members of a coral reef can be arranged in a basic 4 level pyramid based on tropic relations in coral reefs phytoplankton play a relatively minor role in primary production.

Tertiary consumers-

Eels
Barracudas

Secondary consumers-

Octopuses
Sea urchins, anemones
Crustaceans, sea stars
Snails, parrotfishes, butterfly
Fishes, porcupine fishes

Primary consumers-

Corals, clams, sea urchins, crustaceans
Brittle stars, snails, grazing fishes

Primary producers-

Zooxanthellae, calcareous algae, algae mists
Phytoplankton, microorganisms

The Great Barrier Reef, to the NE of Australia, is about 1,600-km/1,000 miles long, has a total area of 20,000 sq. km/ 7,700sq. Miles, and ads 50 million tones of calcium to the reef each year. The world's reefs cover an estimated 620,000-sq.km/ 240,000 sq. mi. coral reefs provide a habitat for adversity of living organisms. In 1997, some 93,000 species were identified. One third of the world's marine fishes live in coral reefs. The world's first survey of coral reefs, carried out in 1997, found around 95% of reefs had experienced some damage from over fishing, pollution, and

day total area of 20,000 sq, m/ 7,700sq.mi. And adds 50 million tonnes of calcium to the reef each year.

DESIGN OF AQUARIUM TANKS

TYPES OF AQUARIUM TANKS

Tanks with dioramic background

It is usually noted that when tanks are decorated with corals, it becomes difficult to clean the corals regularly. Without regular cleaning the corals tend to grow algae on them giving them a dirty look. Hence avoid the corals. A dry diorama i.e. a lighted scene is created behind the wet tank. The light also is carefully selected to avoid the noticeable transition from wet tank to the dry tank diorama. Because light absorption of the water differs from that of air hence the transition is felt. If cool white lamp is used in water area and daylight lamps are used in dry areas, the transition effect is reduced. The following section shows the actual construction of the dioramic background.

Ocean shore tank

This is a tank that replicates the ocean shore, complete with sand, waves and the shoe animal life. Wave machines are utilized here to produce waves so as to create a natural effect.

Giant ocean tank

It is generally a free standing cylindrical tank, 50 feet in diameter and around four stories high with all windows all the way up and down. It has a depth of 25 feet of water. In this 20,000 gallons of salt water live sharks, sea turtles, stingray, moray eels and other marine animals. The giant ocean tank is a large basket of glass and concrete. Compression rings to support the outward pressure of 22 feet of water tie down its precast concrete columns together. The glass windows surrounding the sand are 54 inches wide and 74 inches high. At the bottom of the tank where the pressure on each panel approximates to 15 tonnes, the glass is 3 1/2 inches thick and is made of four laminations. Glass fiber piping is used for the piping purpose to meet the enormous pressure of water. The circulation of this tank contains 200,000 gallons of water. The sand is piled up into a slope, then the rocks are buried deep into the slope of the piled up sand, then the rocks hold the bank in its place and prevent it from collapsing. Rocks or the compositions of rocks are used as a focal point for the fishes to rest. However a number of such elements should be avoided, as shy fishes prefer to go and hide behind them thus deterring their view.

Shark channel or tunnel

The shark tunnel or channel should be torroidal in shape or circular ended to allow for the large turning radius of the sharks. The minimum width should be 24 ft. and a depth of 7 ft.

Coral reef tank

These tanks represent the tidal zone of the oceans. They can go higher to depict the mid and the bottom zone. Though the coral reef tank can be constructed fully in glass the technical and the constructional aspect need to be detailed out precisely. A full glass coral tank requires specific maintenance. To avoid this, R.C.C. tanks can be used such that it is punctured at different levels thus providing the view of the different strata of the coral reefs.

The coral tank is designed so as to give the visitors a feeling of being in water and observing closely the corals without the slightest fear of the above mentioned dangers. A tunnel could be created so as to enable the visitors to have a deeper look at the coral formations. Minimum depth required in the tank is 15ft. (4.5mts).

Conditions required for coral development:

1) Corals are confined to clear water less than 4000ft (122Mts) deep in nature.
2) The temperature should not go below 65 degrees F. (18 degrees C).
3) The water should have abundance of plankton to provide a food supply for the corals.

Following is the typical section of a huge coral reef tank.

Viewing Windows in the R.C.C. Aquarium Tanks:

In case of large tanks, which are also deep enough, such as the dolphin ponds and the seal or penguin ponds, observation windows in the form of portholes can be provided. The container of these tanks is exposed on the outside to the public view. These windows must be provided between two lighting positions. The size of these windows can vary according to the size of the exhibits of the tank or the desired ones. These windows are finished flush with the internal of the tank surface. They should be constructed with toughened safety glass, fixed in corrosion resistant frames. The necessary openings in the pool tanks must be carefully detailed so as to ensure complete tightness. The wall containing the observation windows is exposed to the view of the public and must thus be completely watertight. Seepage, however slight, is usually unacceptable, and special precautions should be taken.

42.

AQUARIUM TANK SHAPES

The aquarium display tanks can have different shapes according to the requirements:

Rectangular block tanks:

These types of tanks are suitable for small fishes or invertebrates living in shoals and measuring 0.3 to 0.8m. In length the size of the tank depends on the number of exhibits to be displayed in it. Usually for proper maintenance, tank capacity is restricted to 1500 to 2000 gallons (6750 to 9000 liters).

Advantages:

Since the form of the tank is rigid it can be grouped to form a row; this type of layout is economical and saves on space. Tank with a height of 0.6m.needs to be arranged by the height of the visitors looking at the center of the tank. Larger heights must have a proper viewing window distance maintained from the viewing tank.

Disadvantage:

Since the arrangement is in a single row it tends to be repetitive and monotonous and hence lead to museum fatigue.

Sloping sidewall tanks:

In these tanks the sidewalls are tilted to an angle, the maximum being 45 degrees so as to avoid the fishes from going out of the vision of the viewers.

Advantages:

Due to the angle of the sidewalls feeling of spaciousness is created as the walls go out of the visual field of man. This sort of an arrangement facilitates better viewing. In all glass construction, side of the tank should be limited to the glass size, fabricated to the required specification. Fiberglass can be used in such cases. It is completely inert, light, readily altered, drilled and can

resist water pressure to a certain limit larger size tanks are possible with the help of concrete for large size species.

Disadvantage:

The main disadvantage is that the spacing of these tanks needs some considerations if it is to be made economical. Also the total volume of the tank is restricted to 2000 gallons.

Rounded side tanks:

In this case the sides are rounded to prevent the aquarium from looking like concrete tanks with rigid forms. They help often to break the monotony. These are helpful especially for the sharks that are incapable of sharp or abrupt turns.

Oceanarium tanks:

Fishes, when swimming, tend to go in circles, especially fish of large size like the sharks and dolphins. Thus the tank can be circular, oval or doughnut shaped as shown earlier.

CROSS SECTION THROUGH TANKS:

Inclined surface:

The surface of the water in the aquarium acts as a mirror, giving an impression that the depth of the water is greater than what it is in reality. To get this effect the viewing glass/wall is built perpendicular to the line of vision of the spectators.

Convex viewing surface:

The convex glass enlarges the view of the exhibits inside the tanks and thus facilitates better viewing.

Concave viewing surface:

Concave glass diminishes the size of the exhibits, in the tank, giving the impression of a wider field of vision.

CONSTRUCTION MATERIALS FOR TANKS

Ideal tanks are those that are least costly, light in weight, readily altered or moved, inert in the seawater, with hard and smooth materials among other things. Though there are many materials available for tank construction, no currently available materials from which tanks may be produced have quite all the foregoing desirable features. The different construction materials are as follows:

Fiberglass:

For small tanks containing about 2000 gallons of water fiberglass or plastic, impregnated plywood seems to be a good choice. Fiberglass is completely inert, light weight and can be readily altered or diluted fiberglass is probably the most practical supporting material for all but the largest tanks since it is lightweight, strong, does not deteriorate and can be easily fabricated into any shape. Adhesives for sealing the tank include epoxy resins, polyvinyl chloride, silicone rubber and neoprene.

Glass:

Sheets of polished plate glass up to 6m. In length can be used. As a thumb rule ¼ inches or 6mm. Thickness of the glass for 12 inches or 30 cm. Of depth could be allowed. Therefore water that is 24 inches deeper requires ½ inches thick glass and 36 inches deep requires ¾ inches thick glass. For an extra safety margin ½ inches should be increased.

Acrylic:

Acrylic is the very versatile, can be shaped into dome, and can be shaped into dome and cylindrical sections. Dome windows that project into the tank can provide an intimate fish eye view of the aquarium. Cylindrical tanks can provide attractive features, particularly effective when housing shoaling fish; tunnel forms also, provide a unique underwater experience. Acrylic can be separated but is a good insulator to cope with temperature differences that would otherwise promote considerations. Acrylic can be assembled with millions, sealant joints or with bonded joints. The latter can create an almost invisible joint, but due to lack of structural mullions would require the panels to be designed to a higher degree of safety. Panel sizes range from window panels 24ft long x 8ft high and 8 inches thick to tunnels 65ft long 5ft radius.

EDUCATIVE PROGRAMMES- THE TOUCH POOLS

The aquariums also undertake a variety of educative programmes for the kids as well as the older people. The main attraction of these programmes is the touch pool. There are more ways to experience the seas and their inhabitants than simply looking at them through the glass, also from the looks alone it is difficult to study important characteristics of the fishes. Is it hard or soft? Does

it have a rigid exoskeleton? Does it have protective spines? What is it like underneath? The answers to these can give important clues to the creatures' way of life. Suddenly the way it looks is less of a mystery. The touch tanks at various restaurants allow the visitors to have a first hand experience of the aquatic life in general. Many plants are delicate enough not to withstand constant touching while some are dangerous to be touched, hence it is necessary to study the subjects of the exhibits. Mostly creatures such as the tougher invertebrates like the sea cucumber, sea star, mollusks of various species and some of the harder corals, several species of encrusting algae growing along the rocks in the tanks along with the small sessile animals like the sea anemone.

To save wear and tear of the animals due to regular touch they can be periodically exchanged with animals from the main tank.

Some other educative programmes such as studying fish skeletons, knowing about dolphin training programmes can also be considered.

49.

STRUCTURAL DETERIORATION IN TANKS:

The majority of materials are inert in marine conditions are non-shrinking and do not suffer from alkaline aggregate reactions which can lead to suffering of the latter.

The other component of the cement plaster binder can deteriorate due to the following causes:

- Marine atmosphere contains salt, which increases the rate of corrosion of the marine structures.

- The deterioration of structures in the sea has most notable effects, which include corrosion of metals, palling and degradation of concrete attack of timber by marine organisms.
- Frost damage cycles of freezing which lead to the disruption of the cement paste by the expansion of the absorbed water on freezing. However this effect is hardly effective in a climate like ours.
- Chemical attack: the sulphate ions present in the sea water reacts with the hydrate of the tricalcium aluminates present in the cement. The steel in the concrete is protected from corrosion by the highly alkaline atmosphere of the hydrated cement paste. This however may be broken by the chlorides present in the seawater leading to the rusting and the exfoliation, which if progressive may create a bursting pressure sufficient to cause spalling of the concrete cover.

The performance of the structures has been in the marine environment has been extensively surveyed and reported by several authors.

Accordingly, they suffer in general limited or no degradation. Severe corrosion occurs only in the 'splash zone' and in particular effects rectangular deck beams, piles and cross bracing pieces. No similar corrosion occurs in the walls or the large circular piles except when the concrete cover is penetrated.

Such deterioration can be attributed to the poor design or poor construction carried out, such as vulnerable shape of the member, inadequate cover to the reinforcement, poor compaction, unsatisfactory design mix or the use of unsuitable materials.

It has been reported that no degradation has occurred in permanently immersed concrete even in structures which have severe corrosion in the splash zone it is seen from the tests, that the durability of concrete depends on the type of material used but also on the quality of concrete mix, normally defined by the cement content and the water/cement ratio. The degradation does not occur with the sulphate resisting cement that has the maximum permissible tricalcium aluminates content of 4% thus several exposure tests have shown that increased durability of concrete with ordinary Portland cement, can be achieved by the

use of clay or other materials as a part of replacement for the several types of slag are available, but the most common is a ground blast furnace slag, which can be used to replace between 20%-

60% of the cement. The concrete thus provided is essentially similar to that of Portland cement though much more durable. Many tests have shown that high alumina cement concrete have excellent strength. However their use is restricted due to high cost.

STEEL CORROSION

The degradation of both steel and concrete is dependant on the zone of exposure. The most susceptible region is the splash zone, with the permanently submerged part of the structure being the least damaged.

STRUCTURAL CRITERION

ATMOSPHERE	ZONE
Decay and attack of timber, corrosion of steel and the spalling of concrete Concrete	splash zone
Moderate to heavy corrosion of steel and spalling of concrete	tidal zone
Heaviest attack on timber by the marine organisms. Failing of all materials	sea water

There are basically three zones of exposure to corrosion:

Above high tide level:

This zone is concrete and mostly in-saturated state and is alternatively exposed to air.

Inter-tidal zone:

This zone is concrete, is mostly in saturated state, and is alternatively exposed to air.

Below low-tide level:

Oxygen available is limited but hydrostatic pressure can also cause rapid penetration of the sea water into the concrete. Although concrete structures have been found to be excellent a durable where deterioration of both concrete and steel is concerned.

Splash zone:

Corrosion of concrete and steel above and below water is fundamentally different with respect to the size of corrosion. Extra measure to deter corrosion in the splash zone must therefore be taken into consideration. Coat the concrete surface with bitumen and epoxy based materials. These must be absorbed into the pores, to be able to reduce penetration. Steel should be galvanized or should be cadmium coated.

AQUASCAPE

A proper and balanced use of the following will ensure the correct ambience for the tank inmates.

Sand:

This should be fine enough for the fish to pick up their mouth, toss around, to forage in to, to rub against, to lay eggs in, but not so small as to mall down. Even though only 1 inch – 2-inch layer provides a base for the plants to grow, but it is needed more to create banks and terraces. Colours of the tank floor should be composed of non- toxic material.

Rocks/stones:

Hard stones, which are devoid of lime, should be used. Other substitutes for rock are colored crystal lamps, which may be translucent or opaque. The advantage of using rock is that if the rock is buried deep into the disinfectant and the seawater is kept circulating, then the water running to the pool is sterilized.

Substrate:

The covering of the aquarium base forms two important functions. Primarily, it is used as a part of a biological filtrated system, it forms a large surface area upon which nitrifying bacteria's can thrive and carry out their purifying activities. Secondly it is used by the fishes that can bury themselves in the substrate at night, burrow into it by the day, or swim through it in the search of food.

Coral sand and courser crushed coral are the ideal materials for this purpose. Use the coarser material to form the lower layers of plastic or nylon netting. The netting will prevent the burrowing fishes from exposing the sub gravel filter plate. The substrate should be sufficiently deep to allow efficient bio-filtration to occur. A depth of at least 5 to 7.5 cms is recommended, and the substrate can be sloped from the front to the rear of the aquarium to an even greater depth. This not only makes it more interesting, but it also causes dirt and other remnants to collect at the front of the aquarium, where it is seen and removed.

Marine floor:

Various points of view must be considered while selecting different plant species to be planted. All chosen plants, possible, should represent the bio top and nature home of the marines. At the

same, allowance for the plants survival should be kept as soft leaves and several fishes eat pinnate leaves of

many plants. Large and fleshy leaves are victims to the claws of the lizards. Shrubs and bushes break down under the heavy weight of the reptiles and large frogs and turtles.

In the landscape and in the crocodile hall, the plants can grow undisturbed by the animals. Here only aphids and other such insects can cause damage. While the extermination of such insects is impossible in an aquarium, a great success can be achieved with geckos-a type of lizard, as natural enemies set out against the destructive insects.

Growing plants in a marine tank is almost impossible, for it requires considerable expertise on the part of the aquarist.

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Common tank plants:

Basically classified as:

1. Emergent plants
2. Floating leafed plants
3. Submerged plants
4. Algae

1. Nuphar sagittifolium spatterdock dreape fear
2. Echinodorus intermedius
3. Cryptocorine willits
4. Hygrophylius polysperma
5. Hygrophylius Guinness
6. Elodeea ernstiae
7. Elodeea dense

WATER SYSTEMS

Types and methodology of working:

There are three basic types of water systems: open, closed and semi-closed.

OPEN WATER SYSTEMS:

In open systems the water flows through the aquarium once and is discarded. This provides water quality comparable to that of the natural environment and there is no buildup of toxic metabolic wastes; however, temperature control and pumping are usually costly and filtration often is necessary. Hence an open system is not preferred.

CLOSED WATER SYSTEMS:

Water is continuously re-circulated in closed systems and is only renewed periodically. Metabolic wastes must be treated since they are not continuously flushed from the system. An important problem is that ammonia must be rapidly removed or transformed because it is harmful even at very low concentrations. In the aquarium the bacteria that converts ammonia to nitrite reside primarily in the filter material and a slow sand filter with a large surface area is usually provided to ensure their abundance. Plant growth in the aquarium, especially in marine systems are not usually sufficient to utilize the entire nitrate produced by bacteria from nitrite. Although some aquariums have operated many years with a minimum of water renewal, it is normally necessary to replace from 1 to 10 % of the water per month to maintain a low level of nitrates. The use of charcoal in both fresh water and seawater system helps to slow down the accumulation of nitrogenous wastes. Metabolic wastes also cause an increase in the acidity of water. Carbonate compounds are commonly used to maintain an optimal level of acidity, particularly when water renewal is infrequent.

SEMI-CLOSED WATER SYSTEMS:

Semis closed are the same as closed systems except that there is a constant connection to the water supply and the problem of dissolved wastes is controlled by the regular addition of new water; this system is more economical than the open type in terms of temperature control and pumping.

Systems vary through simple flow through systems to completely automated re-circulating systems with special provisions for monitoring and controlling the physical and chemical characteristics of water.

The turnover rate or rate of water replacement, of individual aquariums is important and should be no more than two hours. In addition, aeration by means of air stones (diffusers) should be provided to guard against asphyxia in the event of an unexpected water supply failure.

Fishes and invertebrates can also be maintained without filtration or aeration in aquariums that are 'balanced' with plants; however, the balance between plants and animals is very difficult to attain on a large scale or even in a normally stocked aquarium, especially a seawater aquarium.

Freshwater pools for mammals and birds present a special problem. They generally require a higher filtration rate and greater filter capacity because they accumulate large amounts of faecial wastes. Air-breathing animals, however, are not highly sensitive to water quality; thus, chemical treatments, such as chlorination, which could kill fishes, can be used to control bacteria and to improve water quality. Seawater formulas are simpler; for e.g. a 2% sodium chloride solution will satisfactorily maintain whales and dolphins. Seals and sea lions have been kept in fresh water, but this may increase their eye problems because of the osmotic effect of the freshwater on the eye tissues.

CLOSED WATER SYSTEMS

Unless aquariums can be built near a dependable source of water, which is unpolluted, disease free and clear closed water systems become necessary.

Completely closed system in which water is added only to make for the loss by evaporation.

The closed system, which has some flows through.

The site selection need not be dictated by unavailable fresh water source.

Environmental control of various parameters such as salinity, temperature and photoperiod.

Ease of monitoring as storage is in reservoirs.

Convenience of sampling.

Convenience of continuous visual monitoring.

Ease of maintaining several systems simultaneously.

Preferential selection of the biota without the danger of contamination of the water by the plank tonic forms.

Natural water is subject to seasonal temperature fluctuations and may be subjected to nature's effects as storms, floods etc. it may be carry various parasites, pollutants are also taken care of in a closed water systems.
By equipping a closed water system with good aeration and an efficient biological filter the two most serious problems-ammonia toxicity and the change of the ph levels can be greatly reduced.

The following parameters have to be agreed to:
500 liters of cultured water are needed by per kg of animals.
0.1 – Sq, m filter.
0.2 Bed consisting of 2.5 mm grains of calcareous filter containing some magnesium shall be used.
A flow rate of 80 liters per minute through each sq, m of the filter bed surface shall be maintained.
Replacement of 25% of cultured water per month or in some cases 33% every fortnight. The lamp and the water surface will prevent damage and will cut down excessive losses due to evaporation.

FILTRATION IN THE AQUARIUMS

The need:

Aquariums are confined to a limit quantity of water, as compared to the natural habits than in the wilds. In the wilds the fist waste are instantly diluted. While in the aquariums the nitrogenous wastes keeps on building up thus increasing the toxic levels. The waste contains ammonia gases, which are very harmful to the fishes. More the number of fishes more the wastes and hence more the risk of increase3 in the ammonia levels. To remove this ammonia formed in the tanks various filtration methods are used. The bacteria feed on the nitrogenous wastes, decompose it and break down the ammonia into smaller particles called nitrates, which are less toxic rather than being non-toxic. Fishes can tolerate a certain level of nitrate but over a certain period of time these nitrates build up and become harmful, hence they need to be removed from time to time. Since nitrate is a fertilizer excess of nitrate would lead to the growth of algae.

Water changes:

Though there are many ways of filtering water, in case of tanks the best way to remove nitrates is to change the water periodically. The amount of water to be changed everyday would depend upon the nitrate level in the tanks. Thus a regular check of the nitrate level is done to decide the water change schedule.

Biological changes:

It is a term for fostering ammonia-neutralizing bacterial growth. Bacteria decompose ammonia to nitrates which are less toxic this biofiltration is not quite adequate for large number of fishes hence biological filters have been devised which vastly increase the bacteria colony in the aquarium. These filters provide additional surface area for the bacteria to attach themselves and increase the oxygen content of the aquarium.

Mechanical filtration:

It is the straining of the solid particles from the aquarium water. It does not remove directly the dissolved ammonia nor does it remove the algae or the solid particles trapped in the plants and other objects. Wave makers improve the chances of removing the trapped solids through the mechanical filter or vacuum filters can also be used. Mechanical filters use filter material such as sponge paper phlox etc. sponge being the commonest. These filter media have numerous small pores, which trap the particles. These get clogged after some time and need to be cleaned.

Chemical filtration:

This is the removal of dissolved wastes in the aquarium waters. The dissolved wastes are of two types, polar and non-polar. Chemical filtration in case of non-polar can be actively achieved by filtering the water through gas activated carbon. This works best on non-polar wastes though it also removes polar wastes. Polar wastes can also be removed by another method called protein skimming, which is very effective in removing dissolved, organic. Gas is developed from carbon, which is processed to develop large number of minute holes, which trap non-polar wastes at molecular level by means of ion exchange and absorption, and carries out a process of molecular sieving. Reef aquaria people are concerned about the phosphate leaching from activated carbon. Low ash carbons have low phosphate leaching chances and they also reduce the chance of undesirable pH shifts.

Zeolite:

This is another chemical filtrate. Protein skimmers are used in reef aquariums. They have an ability to remove organic matter before it decomposes. The process involves taking advantage of the polar nature of the molecules, which are attracted, to the surface of air bubbles injected by column of water. The resultant form is gathered and skimmed off.

Integrated total filtration:

Modern advancement in filtration technology has produced total integrated systems, which are aimed particularly at the marine end of the fish keeping market. They include some form of mechanical filtration followed by a biological filtration, including a denitrifying filter. For marine tanks, such a set up also has protein skimming. In an integrated system, filter parts are modular and

easily serviceable, but the combined bulk of the systems on top of the tank often make special hood and lighting necessary.

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DIFFERENT TYPES OF FILTERS

- Corner boxes:

  These are internal filters generally made as plastic boxes placed on the corners. These are driven by an air stone, using the principle that when the air bubbles rise in water they pull the water with them. The water is passed through one or more media in a box or cylinder in the tank. This system is fairly inefficient with a poor draw and is now less widely used.

- Under gravel filters:

  Under gravel filters work by passing the water through the gravel layer, this sits on top of a perforated plate. Water can be pumped by airlift with the bubbles lifting water through a water column in a vertical tube attached to the plate. Power heads are attached to increase the flow of water. UGF's are good biological filters since the slow flow of water fosters large colonies of bacteria in the filter, which neutralize the ammonia. But they are bad mechanical filters because the fish wastes get pulled away inside the gravel and it gets clogged.

  A reverse flow under gravel filter is available to solve this problem.

- Sponge filters:

  These provide an efficient and economical form of biological filtration. Water is forced through the porous foam by means of power, heads or by bubbling air-by-air tubes. The flow of water through the foam fosters the growth of bacteria in the foam and biological filtration takes place.

- Power filters:

These consist of a siphon tube, which pulls water from the tank into a filter box and passes it through a mechanical filter. The sponge acts as a double filter media for biological filtration to take place. An internal filter then returns the filtered water to the aquarium. These power filters are much easier to maintain like the power filters are available in a variety of sizes a design as suited to the requirements of the tanks.

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Power filters are also available with a number of fancy features. Many are assorted with chemical filtration media such as granular activated carbon.

- Canister filters:

  These are designed for powerful mechanical filtration. The water is pumped, at moderate pressure, through a filter medium such as glass wool or micron filter cartridge. They are useful in aquaria having large messy eaters. They can be hung on the tank. When they sit on the bottom of the tank they are known as submersible filters.

- Trickle filters:

  These work on the principle that the beneficial colonies of ammonia nitrifying bacteria grow best in the presence of well-oxygenated water. By trickling over unsubmerged objects, the wet/dry filters provide a large surface area. They are available in many shapes and sizes. The boom in successful saltwater aquariums can be contributed to the use of this kind of filters.

- Protein skimmers:

  Protein skimmers were initially developed for uses in industrial sewage treatment plant where they are also known by the term foam fractionate. Protein skimmers have the unique ability to remove dissolved organic wastes before they are decomposed. This is accomplished by the fact that organic matter is attracted to the surface of bubbles, which are partial large numbers through a water column. The foam is then skimmed off the water, and at the same time removing the organic wastes. The foaming process only takes place3 in water. Of high pH and salinity and hence this system is only used in marine water aquariums.

- Denitrators:

These work on the principle of biological filtration. These fall into categories, the anoxic bacterial and plant/ algal scrubbers. It works on a principle discovered that colonies of bacteria which grow in oxygen poor environments can be harnessed to biologically consumed ammonia and release harmless nitrogen gas. This was done by two methods. But reported failures were heard about this type. These aquariums involve the use of large amount of harvested from tropical reefs, which are reported to have good nitrogen content in the live rocks.

- Algae scrubbers:

Algae scrubbers make use of live algae to do the filtration. The water is run over a wire mesh in a trough under bright lights, where algae are encouraged to grow. The growth of algae removes some pollutants from the water. This is a controversial form of filtration for the reefs and large marine ecosystems. Some are of the opinion that if the complete filtration solution others are of the opinion that it leads to poor water quality and algal growth in the tank as well.

One interesting characteristic and underlined principle behind this growth of turf algae is the necessity for grazing by members of the animal population. The algae must be cut back or grazed, much like the grasses in the backyard or the other spaces, which are not as efficient at removing nutrients from the system, will develop. The use of 1000 micro window screen allows easy scrapping of the algal filaments and provides a protective matrix in which the basal portions of the algae can grow. The screen is removed from the tray, scraped with a piece of straight-edged perspects rinsed and placed back into the tray. The algae that has been removed, along with the absorbed nutrients is dried in an oven and weighed. This is done to help determine how efficient the scrubber is during various times of the year. The algal turf scrubber is a way of increasing surface area for algal growth and the greater efficiency and removing nutrients.

Algae are the key to keeping the water clean. They remove waste from the water and put oxygen back in at the aquarium they are found outside the tank. The farm grows special algae in 72 separate shallow trays (scrubbers) on the roof of the building. In each scrubber algae grow on 2 m. –square plastic mesh screens over which the aquarium water is passed

in a surging motion to increase the growth rate. The algae grow quickly, forming a lawn, which requires a mowing every 5 to 14 days. Mowing involves scraping the algae from the screens with a piece of straight-egged perspires. Productivity of the scrubbers can be increased by the use of powerful 1000-watt lights at night to extend the effective day length for photosynthesis.

- Sterilization: In especially sensitive aquaria the infections resulting from water borne parasites, fungi, bacterium, and virus can cause serious problems. Water sterilization is most important for breeders, for centralized multi-tank filtration, for delicate and closely spaced setups such as large tanks and reef systems. Healthy aquaria depend upon beneficial bacteria growing on the filter media, which neutralizes ammonia. Total sterilization is not desirable. Two main types of sterilization are used ozone injection and ultraviolet irradiation.

- By ozone:

  Ozone is highly reactive and is a powerful oxidizer of organic pollutants, including live pathogens. It also systematically reduces dissolved organic compounds in the water stream, which increases the reserve capacity of the water to oxidize organic waste through the aquarium. Ozone laden water also improves the ability of protein skimmers to generate foam, which increases their overall performances. But ozone gas is highly corrosive and is very unsafe for breathing hence is not recommended.

- Ultraviolet sterilization:

  High intensity ultraviolet light destroys the DNA in the living cells and can be used as an effective means to control living pathogens. The most effective light is the high energy UV light roughly around the wavelength of 250 angstroms. To be effective the UV light should expose the pathogens to a high enough light intensity for a long enough period.

PIPING IN THE AQUARIUMS

All the piping should be of non-corrosive and chemically inert materials. Non-wettable pipes with smooth interiors should be used so that the chances of the marine organisms getting a hold and forming colonies are reduced. Piping should be preferably non-metallic as even lead and steel, which are generally considered safe, are affected by seawater. Where unavoidable metal pipes are used as to se cetaceans, seals, penguins but this may prove clear in the long runners expensive replacements are generally required due to corrosion. The use of copper for piping should be absolutely prohibited.

The materials most commonly used for the pipes are
Rigid PVC
Vulcanite
Ebonite
Fiberglass
Cement line steel pipes
Cement lined galvanized iron pipes for fresh water.
Thoroughly cured cement concrete pipes

The water is first pumped to a height and then fed to the tanks by gravity. Thus the water in the pipes is under pressure and they should be designed with adequate strength to resist it.

The piping should be placed under the service passage and neatly stored in drainage gullies with a narrow feed pipe to each tank. Feed pipe should come up in through the tank bottom so that the water enters the bottom and overflows to the tank. The ideal solution is to line up the feed at the top eliminating any layer of dead water at the bottom ensuring proper circulation and consistently ample oxygenation and an encouraging specimen to occupy the whole of the tank. The ideal solution is the line up of the feed oxygenation and an encouraging specimen to occupy the whole of the tank. The ideal solution is to line up the fresh water pipe with the drainpipe. Thus, by opening the feed valves, the correct water amount can be introduced by closing these and opening both, the tank can be rinsed, only or all of these operations can be done at the same time.

Inlets

The covers over the openings of feed pipes inside the tanks have to be finely perforated to let water through but preventing the specimen from entering the pipe. Sharp turns are acceptable with metal pipes. Short turns should also be avoided with large diameters as required.

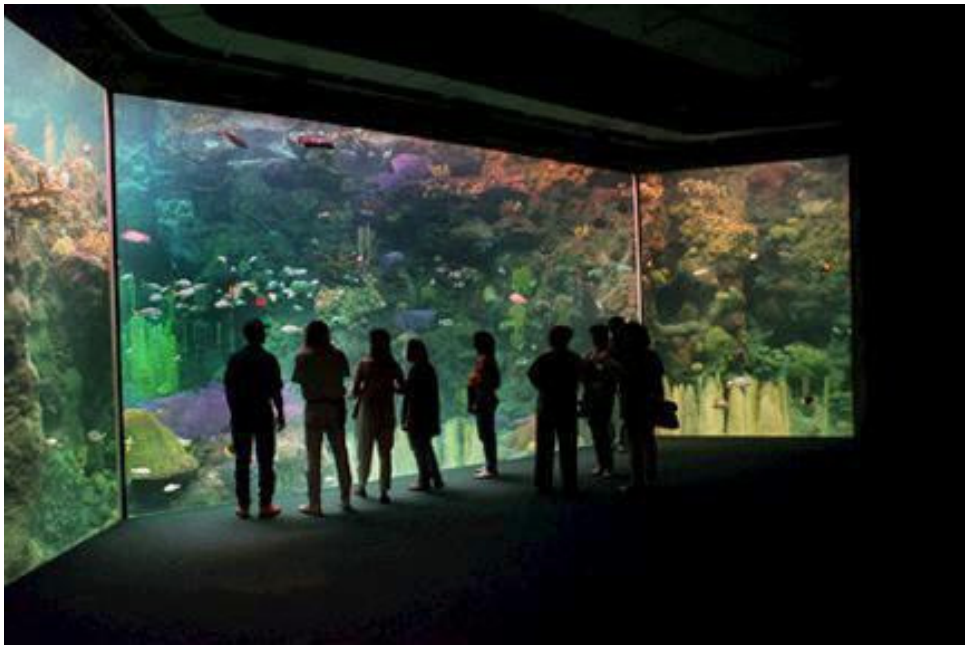
All the electric installations, plumbing or airlines should be embedded in the concrete. External piping should not be embedded in loose soil.

Reserve water

The reserve water is used mostly for routine replacement. Its quantity may equal the gallonage of the largest single display tank, if it considerably exceeds that of the others. In such cases the water could be adequate for more contingencies except catastrophic disaster. Reserve water is used to compensate cleaning losses; evaporation losses and to provide fresh water in order to avoid build up of harmful bacteria.

LIGHTING IN AQUARIUMS

Lighting constitutes a highly important and a highly sophisticated part of an aquarium. For keeping the aquarium healthy, well balanced and flourishing, it is essential for the aquarist to take proper notice of the lighting in the aquarium. A perfect aquarium should have electrical lighting supplementing the natural lighting. In an aquarium it is necessary to provide the proper lighting. Some lights can stimulate groups of brown algae as natural light does, but in a fresh water system plants thrive best in little sunlight than in electrical light plants are very demanding in their light preference hence it is necessary to provide the correct type and intensity of lighting required. The entire inhabitant fishes as well as plants have specific requirements of light. Although they may survive in not so ideal conditions they may not necessarily flourish.



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Types of lighting

Lighting manufacturers have responded to the different needs of the aquarists by providing a range of bulb type and qualities.

In general the human eye responds to the aquaria lit with yellow green light because it appears warmer and more appealing. Plants however prefer red/blue ends of the spectrum. Although some light is absorbed in the water, the average aquarium is not deep enough or normally not cloudy enough, for these to make an appreciable difference.

1. Natural lighting

This is a correct spectrum range for all animals and plants. This encourages algal growth. But this is quite unpredictable and uncontrollable. Excess of sunlight would cause excessive growth of algae, which would suffocate the aquarium.

2. Tungsten lighting:

These are extremely unsuitable as a form of illumination for any type of modern aquarium. They do not give an optimum light spectrum for good plant growth and are efficient, converting most of the energy into heat, rather than into useful light output. They are therefore no longer recommended as they have nothing to offer to the aquarist.

3. Fluorescent lighting:

Fluorescent tubes are the most suitable form of aquarium lighting. They give a better spread of light and are relatively cheap to run in cool operation.

4. Enhanced red/blue:

Output contains the correct spectrum for the plant requirements and is thus good for plant growth. Light output is low, however therefore this type of lighting is generally used in conjunction with full spectrum bulb.

5. Full spectrum:

This stimulates daylight and is extremely useful where space permits only one bulb.

6. Spot lighting:

These are ideal for creating dramatic and for emphasizing any surface water movement. They are particularly useful for punching light down to the relatively deep tanks. Focusing the spotlight on a particular tank will benefit the sea anemones, for example who will migrate to that area to look into the brighter spot.

7. Mercury Vapor lamps:

The point source light produced is bluish white, which gives a sea bed effect will sow fishes off in their best colors in the aquarium. These are suitable for large public aquariums, where their light output can be color corrected with a supplementary lighting in a different spectral balance.

8. High pressure mercury vapor:

High power lighting for tanks deeper than 45 cms. It is less costly than metal halide; it has a fairly broad spectrum, but is lacking in blue/green wavelengths and requires blue supplementary lighting.

9. Metal halide lamps:

Although its lamp has a tungsten filament, it produces a more intense light that an ordinary tungsten lamp. Any tungsten evaporated from the filament at a extremely high operating temperature combines with the halogen vapor within the quartz envelope of the lamp and is re-deposited back on to the filament, extending its effect on us. Mounted 30 cms above the tank, in a suitably designed reflector, a 150-watt lamp will illuminate the area of approximately 1800 cms. This light is more pleasing than pressure mercury vapor because it has improved red/yellow output. Produces an intense light suitable for marine tanks, especially the deep ones. This is the most expensive form of lighting and is usually requires a large housing.

Installation:

Duration and intensity of lighting:

The lighting should be kept on for at least 12 to 15 hours a day, but the intensity can be reduced from its full intensity to a low level for evening viewing, in as semi natural aquarium the aim is to have a reasonable light for algal growth that does not take up the entire aquarium space. As a whole one should allow 5 watts of power per

100 cms of water surface area. In a 300 mm tank it works to around 135 watts. Four thirty-watt tubes should suffice for this.

Temperature:

For economic reasons it is desirable to maintain an even temperature of 72 degrees f. is comfortable for the visitors and will maintain display tanks temperature also at the same level. A great many fishes and organisms are comfortable at this temperature. Heat exchange equipment can be provided for the individual tanks when warmer or colder water is desired.

Care and uses of light:

Whatever lamps one uses they must be protected against water damage either from direct spray and splashes, or from condensation. Water proof lamp fittings safeguard the electrics and a glass cove; fixed on the top of the aquarium between the lamp and the water service will prevent the damage and cut down the expensive evaporation losses.

Guidelines for good light:

The goal of architectural lighting is to create the visual environment that the best accommodates the function intended. Visual comfort results when we are able to receive clear visual information that we intentionally or consciously want to receive. Some general guidelines for getting good lighting are given below:

Visual conditions should be made comfortable and should conform to the acceptable quality of light. Also the light sources must not be a source of discomfort glare.

Visual conditions are improved if the visual conditions are distinguished from its surrounding by being brighter, more contrasting, more colorful, strongly patterned or a combination of two or more of these factors.

Sufficient overall light should be provided in rooms with focal light on the visual task. Avoid creating conditions where the eye will have to adopt too quickly over too great a range of brightness.

Dull uniformity should be avoided. For example small point of light from low wattage light source can contribute ‘sparkle’ without glare. Sparkle or glitter occurs when a pleasant combination of luminous brilliance is achieved.

Flat surfaces should be evenly lit unless focus is to be laid on art, Panels etc.

Enough light must reach the ceiling in order to avoid gloomy conditions., which occur when desired visual condition on structures is missing.

Light sources should be selected with regard to color rendering needs of people, finishes and paintings.

Surrounds should be moderately bright. Reflecting from the wall and ceiling surfaces should provide for the light.

Daylight should be provided through openings to achieve contact with nature and people and to induce feelings of well-being and freshness. Variety of light is the dominant daily characteristics of natural light.

Recommended lighting:

Illumination category	Ranges of luminance maintained in lux (fc)	Type of activity

General luminance throughout the room

A	20-30-50(2-3-5)	Public spaces with dark surroundings,
B	50-75-200 (5-7,5-10)	simple orientation for temporary visits.
C	100-150-200	Working spaces where visual tasks are only occasionally performed

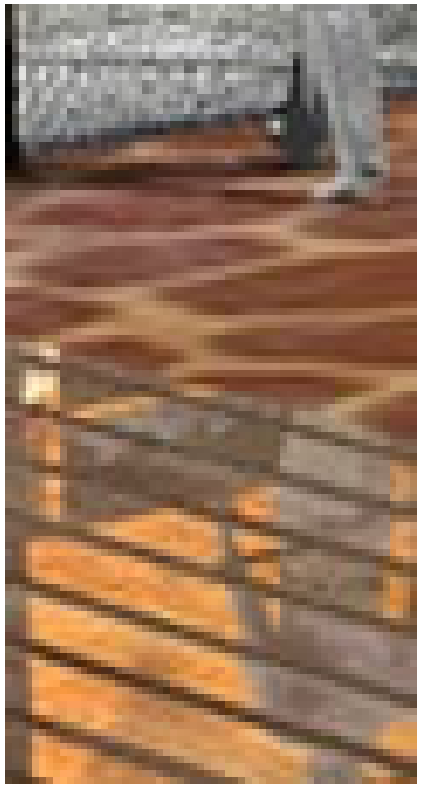
Luminance on task:

D	200-300-500 (20-30-50)	Performing visual tasks of high contrast or large size, reading print material, typed originals, good xerography, rough benches, and machinery work, ordinary inspection rough assembly
E	500-750-1000	Performing of visual tasks of medium contrast or small size, medical bench, and machine work, difficult inspection, modern assembly.
F	100-1500-2000	Performance of visual tasks of low contrast or very small size, high difficult inspection.

FLOORING IN THE SERVICE AREAS

A non skid surface can be achieved by the application of a chlorinated rubber permit or an epoxy resin or polyurethane followed by a sprinkle of fine sand before the paint or the resin has hardened.

For economic reasons it is desirable to maintain an even temperature throughout an aquarium structure. A temperature of 72 deg. F (22 deg c.) comfortable for the visitors and will maintain display tank key also at the same level.



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ANIMAL LAB:

Facilities in which the animals are housed regenerate from rooms for small species to central quarters for small species and large ones. The central animal facility may be inclusive of the following:

Receiving and examining areas for the animal food and supplies.

Quarantine rooms for housing the animals with provision for the separation of the species and the isolation, sterilization and storing cases and equipment.

Laboratory for the surgery, radiology and other procedures.

Administration office.
Showers, lockers, toilets and luncheon for personnel.
Incinerator for the animal wastes and refuses.

WAVE MACHINE ROOM

The scientific concepts of the wave motion in the ocean circulation can be by the use of wave machine. There are numerous types of wave machine and the plenum chambers are normally positioned in deep water area of the pool facing the beach, which absorbs amount of wave reflection.

Design consideration:

The height of the pool surrounding from the still water level around all sides of the pool needs to be considered. This is critical and depends on the wave height, floor slope and the pool shape. Tests can be carried out in the conjunction with the wave machine manufactured/ supplier to determine the wave profile for the particular scheme and thereby keeping the surrounding height to minimum.

The position of the learner pool in relation to the main pool will also need to be considered, as it needs sheltering from wave machine turbulence. The overall size access and ventilation requirement of the fan and the motor chamber needs attention. There have been reports of motors overheating as a result of poor ventilation.

The pool needs to be about 35 cms long to accommodate 700-900 mm waves at 10-12 m centers. The pool should have a minimum depth end of 1.8 m and allowance must be given in the height of the wave at the deep end to zero at the beach end.

CONTROL OF AQUATIC VEGETATION

Not only for their beauty but also for their function are plants essential for the balance tank. It is merely a tragedy that they cannot be used efficiently with the marine fish. The lighter green the plants the more fast rowing it is and more food it requires. It also sheds more leaves, which are small or thin, and requires more warmth in winter. If the slow growing types are left unprunned for a couple of years they might alter the pH to suit themselves to the determiner of the fish whose health then definitely plays second fiddle to the plant growth.

The other importance of the plants in the tanks is stated below:

1. Aerates the water by the process of photosynthesis. Much of the oxygen produced by the plants is removed by respiration during the day by the animals and at night by both the plants and the animals.
2. Acts as a shelter for the animals also many species of fishes and invertebrates deposits their eggs on these plants
3. Consolidates the bed and the banks of the fishery.
4. Provides food for other organisms.
5. Intercepts silt and plant debris.

DESIGN OF WORK AREA

1. The various main supply pipes from the reservations should extend around the aquarium over the display tanks. These should be a minimum of 7ft. above the work area floor and should have frequent tap valves from which, by flexible nose, replacement water or a continuous flow may be fed top the tanks depending upon the system. It is important to have shut-off conveniently located along the major supply lines to facilitate plumbing repairs.

2. All electrical appliances and equipment including connecting boxes must be grounded. Outlets should not be located near the work area.
3. Fixtures over the tanks should be protected to avoid breakage and possible danger to personnel working in the water. Poles attached to cleaning brushes or other cleaning devices should be of wood or other non-metallic material.
4. North lighting should be kept at a minimum, unless completely controllable.
5. A clear passageway of about 6ft. wide should extend along the back of all the display tanks, in order to permit easy transport of tanks.(in case of loose tanks), incoming specimen, etc. by using forklifts truck or four wheel flat bed. No stairs or other obstacles should be located in this passageway.
6. The floor surface of the work area should have a non-skid finish. Floor drains with sand traps are absolutely necessary and floors should be sloped to the drains. All other adjacent places to tanks should be made of water resisting materials.
7. Storage space for tools, nets, chemicals and other items in fr4equent use should be provided not far away from the work area.
8. Refrigerators, often, are convenient from the work area to the public area with locked doors.
9. Deep washbasins with hot and cold water and towel boxes should be located conveniently from the work area to the public area with locked doors.
10. Stairs should be placed conveniently from the work area to the public area with locked doors.

11. Centrally located and convenient to the live exhibits should be grouping of the loading dock, preparation room, and freezer, office for the biologist and chief aquarists, a room for the shipping and receiving of specimen and the crew room with showers and toilets. Space for the chief engineer and control and monitoring panels should be provided.

12. The above can be located on either the work area level or the public area level. It is also desirable to have easy rolling access to the public area and the administration offices.
13. In any well-equipped aquarium a two-way intercom system from crucial points is very important.
14. The work area should be acoustically separated from the public area.
15. The interior windows may be desirable to permit visitors to view the more interesting operational features.

DOLPHIN POOLS

The most popular swimming pool built for animals is the dolphinarium. The pool should be shaped to allow the dolphins to swim easily and safely at a speed, and should provide facility to watch them from below the water. Adult dolphins vary in sizes from 2 to 3 meters long and weigh 200-300kg. Dolphins can reach a speed of 60 km/hr within a few meters. They surface every half-

minute to breathe, although they can remain underwater for a period of 6 to 7 minutes. Dolphins like to show off and display. They navigate by sound, their sonic system adding information to sight.

The dolphins are good learners and they learn tricks very fast. After a day of 4 to 5 performances and feeding upon fish, unfiltered water becomes turbid with up to 10 liters of highly nitrogenous waste matter per dolphin, uneaten fish scales and lollipop sticks. The oil slicking has to be prevented by rapid surface water drain off, with large main drains to collect the heavy debris, which the dolphins themselves by activity and agitation, help sweep the floor. Extra prestrainers to the filter pumps are particularly important and should be cleaned regularly to reduce the load on the large capacity filter beds and total oxidation disinfections like humans, dolphins suffer water-borne diseases such as conjunctivitis, fungal skin disorders and worm infestations. When the public close behind the pool, especially indoor dolphin areas the safety glass partition barrier along the pool experiment not only stop the water splashing but also helps reduce the spread of contagious diseases like coughs and sneezes to the dolphins. Healthy dolphins enjoy their shows and worms should be neutralized immediately by residual disaffection, which gives better water quality too. The filtration should keep the water clean all day long in order to see the dolphins, especially in the last performance.

Dolphins and their operators prefer seawater to converted fresh water and try to maintain 2 to 5% daily dilution rate as replacement to the water. The fall off of the total dissolution salts in the artificial seawater necessitates an alarm system to signal correction before the health of the animal is affected. Liquid chlorinating is expensive and alkaline, so gas systems, properly neutralized or

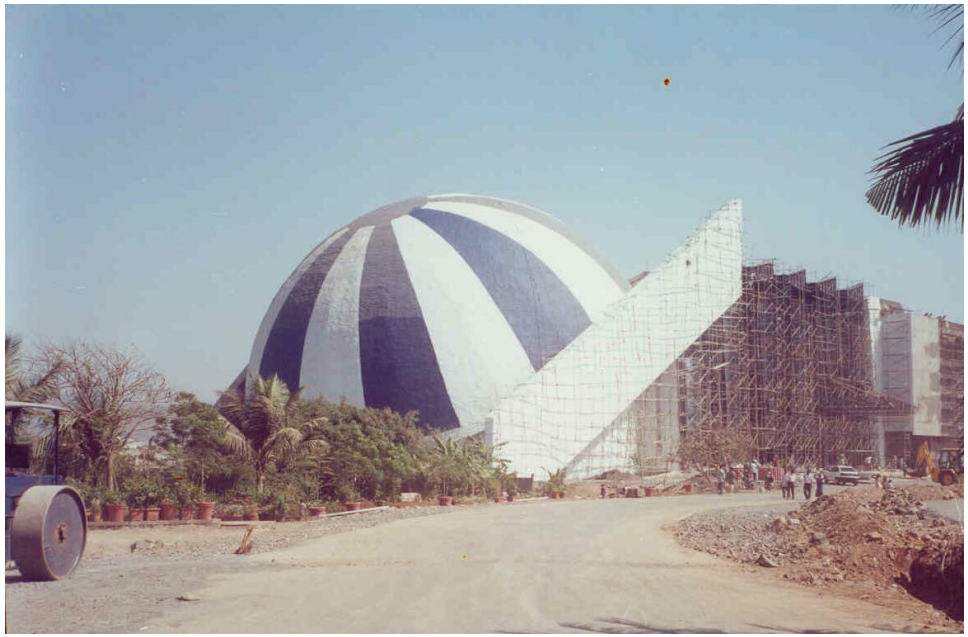
electrochemical cells are often more practical. Iodine as an alternative to chlorine, although uncommon, can be equally effective and less troublesome to sensitive animals.

78.

OMNIMAX

Design considerations for an Omnimax theater

The information contained in this Omnimax design considerations is intended for general information only. Consult Imax Systems Corporations Design Department for the details pertaining to any specific Imax or Omnimax theater before starting design.
Imax Systems Corporations policy of ongoing technical improvement means that all design information is subject to change without notice.



INTRODUCTION TO OMNIMAX

The Omnimax Motion Picture System is more than a variation on conventional cinema. It is designed using entirely different criteria, to provide a high fidelity audio-visual

experience in which the film envelops the audience. In effect the screen and the theater become one; with boundaries set not by architectural volume but by the vistas of the projected film.

The strong sense of reality unique to the Omnimax presentation is achieved through a variety of techniques.

1. The large dome screen surrounding the audience permits the picture to extend beyond the field of geometric recognition to the edge of peripheral vision, as well as overhead. As in the world outside, viewers must move their eyes and head to take in the entire picture.
2. Omnimax theater seating is steeply raked, usually ranging from 25 degrees to 30 degrees and the bottom edge of the dome is placed so that th3e audience looks down as well as up and to the sides. In this way the horizon appears in the natural position for most viewers.
3. The large image is achieved by an exceptionally large film format (10 times the usual 35mm film format area).
4. The projector has a unique ‘Rolling Loop Film movement which not only produces images of superior stability on the giant screen, but, because of the smooth handling of the large format film, assures a long print life with assuring high quality pictures.
5. Picture contrast and brightness are maintained at a high standard by meticulous attention to the design of both the screen and the illumination system.
6. A multi channel high fidelity sound system surrounds the audience with natural directional sound that completes the illusion of being at the center of the action rarely than being a spectator.
7. The ambience of an OMNIMAX theater must be one of quality, audience comfort, thoughtful planning of facilities and tasteful décor are all essential elements.

Thus the Omnimax experience depends not only upon a revolutionary new technology for making and projecting motion pictures, but on careful planning and precise designing of the theaters where the Omnimax films are shown. The following pages offer some of the basic points to consider when planning such a theater.

QUESTIONAIRE

1. WE WANT TO BUILD AN IMAX THEATER. WHICH IS THE BEST WAY TO PROCEED?

   Assuming you have done the market research and know the size of your potential audience, have your architect consult with Imax Systems Corporation's design department to establish the basic theater layout.

   Because correct theater geometry and design are essential if the audience is to have a satisfying Omnimax experience, Imax systems corporation has vested interest in seeing that each theater is the best possible. We expect to provide consultation on planning and costing before the signing of the contract.

2. WHAT SPECIAL ARCHITECTURAL AND DESIGN FEATURES MUST BE CONSIDERED?

   Mainly the tilt and positioning of the dome and the placement of the projector in relation to the audience; we refer to this as the 'theater geometry'. Every situation is completely unique.

3. HOW LARGE A BUILDING WILL BE REQUIRED?

   That depends on the size of the market you plan to serve. Box office, lobby, entrance and other amenities will occupy the remaining area. The mechanical services areas should also be provided for.

4. ARE ALL OMNIMAX THEATERS ROUND?

Not necessarily as the dome shape of an Imax theater can be fitted into any shape.

The Omnimax Theater in Pueblo, Mexico is a pyramid and that in villa Hermosa is in the shape of a Mayan astronomical complex.

5. WHAT IS THE SIZE OF THE PROJECTION ROOM?

An Omnimax projector booth is considerably larger as compared to the normal projector room. The projector and reel unit occupy floor areas of 12 square feet and together weigh 4200 pounds. This is located below the audience. It is usually exposed as a state of art mechanical equipment.

6. HOW MANY PEOPLE ARE REQUIRED TO RUN AN OMNIMAX THEATER?

Two people are only required for the movie along with them the ushers and other services require another 4 to 5 people.

Details to be followed

Audience flow:

The entrance exits and steps should allow easy flow of audience. It is always better to enter at the base and move upwards to the exit.

Audience safety:

The contrasting tread noses and railings make the Omnimax safe.

Audience seating:

The theater seating should be on either side of the doghouse and it is mandatory to provide for wheelchairs too. The audience's eyes should see the screen more easily and the seats should be high enough to provide headrest.

Air conditioning:

The air conditioner should be on throughout for maximum comfort to the patrons. However the theater should not be allowed to become increasingly humid as this can affect the screen and the loudspeakers.

Noise control:

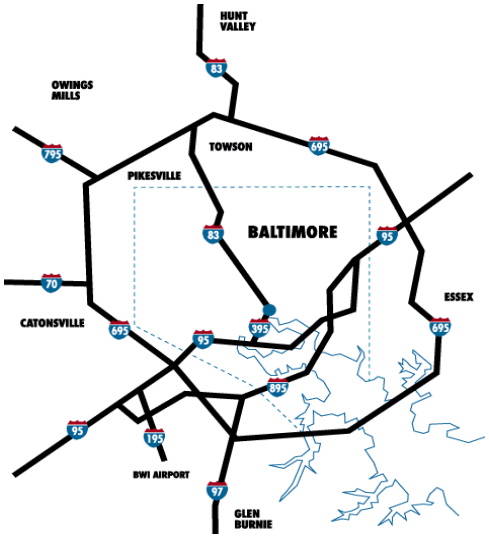
The heavy machinery should be sufficiently noise proofed and even the vibrations from these should not be transmitted to the theater. The external noises of the highways etc should also be taken care of.

NATIONAL AQUARIUM, BALTIMORE

PROJECT: the National Aquarium at Baltimore
PROJECT ARCHITECT: Cambridge seven associates inc. Cambridge, Massachusetts.
PROJECT COST: $21.3 MILLION.
BUDGET: $12 MILLION
COMMENCEMENTS: AUGUST 1, 1978.
DATE OF COMPLETION: AUGUST 1981.

LOCATION:

The aquarium is located on Baltimore's harbor front as a part of a plan to revive the harbor. The aquarium and the marine mammal pavilion are connected with a bridge. They are placed on two piers. As these piers jut out in the sea it gives an impression of the structure floating on water.



WATER CAPACITY:

The aquarium holds more than million gallons of salt and fresh water.

NUMBER OF SPECIMEN:

More than 5,00 specimens, representing 500 species of fish, bird, reptiles, amphibians, invertebrates, and plants and marine mammals.

EMPLOYMENT:

A full time staff of 225, assisted by a part time staff of 22, works in four operating departments:

- Development and administration
- Marketing and visitor facilities
- Research and animal affairs
- Programs

EXHIBITS CATEGORIES:

The aquarium has uses sophisticated theme exhibits areas as under.

- Wings under water-
  It is a ray exhibit. Southern stingrays, cow nose rays and blunt nose rays, etc. 50 rays in all can be seen gliding in this ray exhibit. The visitors learn about these striking, mysterious and misunderstood species of the sea while examining theme in their spectacular 260,000-gallon salt-water pool.
- Atlantic coral reef-
  Contained in a 13 ft deep doughnut shaped tank, this exhibit features dazzling tropical fishes swimming throughout fiberglass simulation of the coral reef. It holds 335,000 gallons i.e. 15,24,25,000 Lars of water.
- Open ocean-
  Also called as the shark tank this oval tank houses several species such as sandbars, sand tigers, etc. it holds 222,000 gallons of water.

- South American rain forest:
  This steamy foliage laden stimulation of the South American jungles reproduces the stratification of plant life in a neo tropical rain forest. Over 700 species of tropical plants thrive in the 64 ft. tall glass pyramid atop the aquarium. It also contains 25 species of fish including tetras and piranhas. It also houses over 30 brightly colored tropical birds such as hawk headed parrots, blue crowned mot-moths and tanagers.
- Sea pool:
  70,000 gallons i.e. 318,500 liters, capacity pool houses numerous harbor seals and a pair of gray seals.
- Surviving through adaptation:
  This exhibit consists of 22 galleries. The visitors experience the complex and often beautiful adaptations of various marine animals and to discover how these

adaptations help the animal to survive in its environment. These include the following:

a. Long fish and their defensive spikes.
b. Deep-sea pinecone fish and their bio luminance.
c. Sea anemone and their brilliant colors.
d. Octopus and their giant specifications.
e. Electric eel.

- North Atlantic to pacific gallery-spans planets oceans.
- The children cove on this floor allows visitors of all ages to handle inter tidal marine animals. Computerized display depicts effects of human activity.
- On tropical rain forests.
- Mountains to the sea.

1. Allegheny mountain pond
2. Tidal marsh exhibit.
3. Coastal beach.
4. A simulation of the Atlantic shelf.

- Noteworthy places:
  1. Habitat theaters-slide shows daily
  2. Amphitheater –1300 seats
  3. Auditorium-275 seats
  4. Pier 4 gift shops
  5. Puffin place (souvenirs and gifts and educational material)

SERVICE AREAS:

Since water borne site precluded placing the aquariums extensive mechanical services and staff areas below grade these occupy the plaza level and one level below. Public places are

introduced by a pyramid capped raised platform. Services occupy an area of more than 50% of the total aquarium area.

SPECIAL FEATURE

It has an unusual multi layered display system.

The design is based on one-way route leading visitors upward into a rooftop green house and then downward within the center of a two level ring tank. Specially designed elevators for handicapped persons to enter the building through the members, entrance on wharf level. To create the moods of the undersea world they used all the tools available for advanced exhibit design and audiovisual communication and taped sound effects.

EDUCATIONAL PROGRAMS:

The aquariums department offers three major types of programs for the Maryland school children in kindergarten through college. In classrooms program school visitors discover animal adaptation by examining living animals and artifacts. Gallery classes explore the ecology of the aquariums and habitats, and the auditorium programs use slides, films and props too focus on specific group of animals. Training programs at the aquarium includes college internships and volunteer positions for community residents.

AIM:

The aquarium is committed in making known the unity of life through water with a combination of recreation and educational and research programs. The aquariums main form is conceived as a device for the organizing a progression of the experience so involving that you forget the architecture. Within the building the orchestration of exhibits is so merged with their visual and spatial framework that the architecture becomes invariably a part of the visitors, an within the building the orchestration of exhibits is so merged with their visual and spatial framework that the architecture becomes invariably a part of the visitors, an experience. Cambridge seven, the planning team, aimed from the very beginning to plan the aquarium and

its contents to give an experience more engaging than just staring at the incurious gaze of the fishes in the tanks. The subject was conceived to be not the ocean alone or even any contained water bodies such as lakes, rivers, ponds etc. but water itself as the basis of life. The various exhibits accordingly combine the best of the zoos in the form of display of a wide range of aquatic life, mammals, birds, amphibians and plants as well as fish. The aquarium combines these displays with the natural history museums through pains taking elucidation of the inter-relationships among species in complex ecosystems.

STRUCTURAL ANALYSIS:

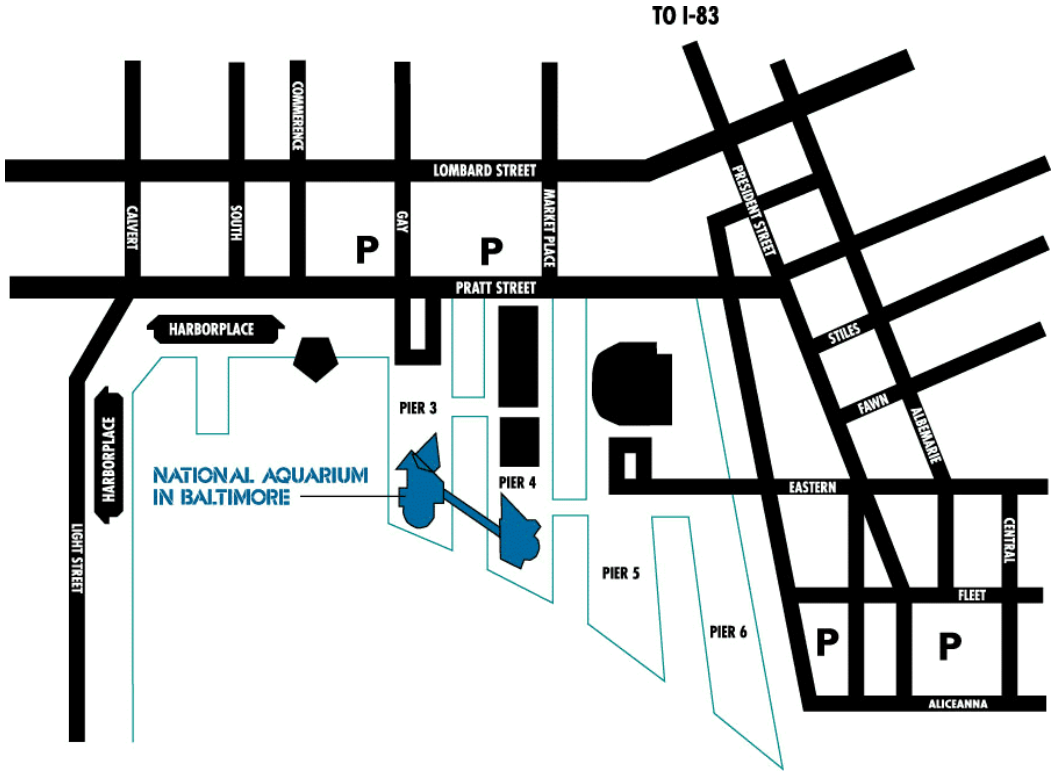
The building is a complex mass of the steel and reinforced concrete, build up to seven levels. The building sets an image of a huge sea bird gracefully afloat. The structure is visible from all sides and each view adds to the overall composition. The building is built on a pier and seems perched on it.

Internally the aquarium is designed to have a five level atrium gallery, which at the top is covered by a triangular glass pyramid. This pyramid houses a simulated rain forest. Another major exhibit is the interlocking oval shaped ring tank. On the exterior side of the building are located the smaller areas such as the auditorium and an elevated entrance platform sheltered by a smaller glass pyramid. The building has a total footage of 115,000 sq.ft.

CIRCULATION:

The raised platform capped by a glass pyramid roof forms the entrance to the visitors. The platform is raised through overlook the inner and the outer harbors, the city skyline, and the flag are bedecked fore court of the aquarium itself. From the lobby situated adjacent to the entrance starts a unidirectional continuous path through the building. The unique circulation pattern is the key of the entire display orientation. The path zigzags up through the central

atrium lined by exhibit galleries, and emerges at the roof top where there is situated the rain forest simulation, it then winds down again via zigzag ramps through the center of the huge ring tank.



89.

Detailed circulation:

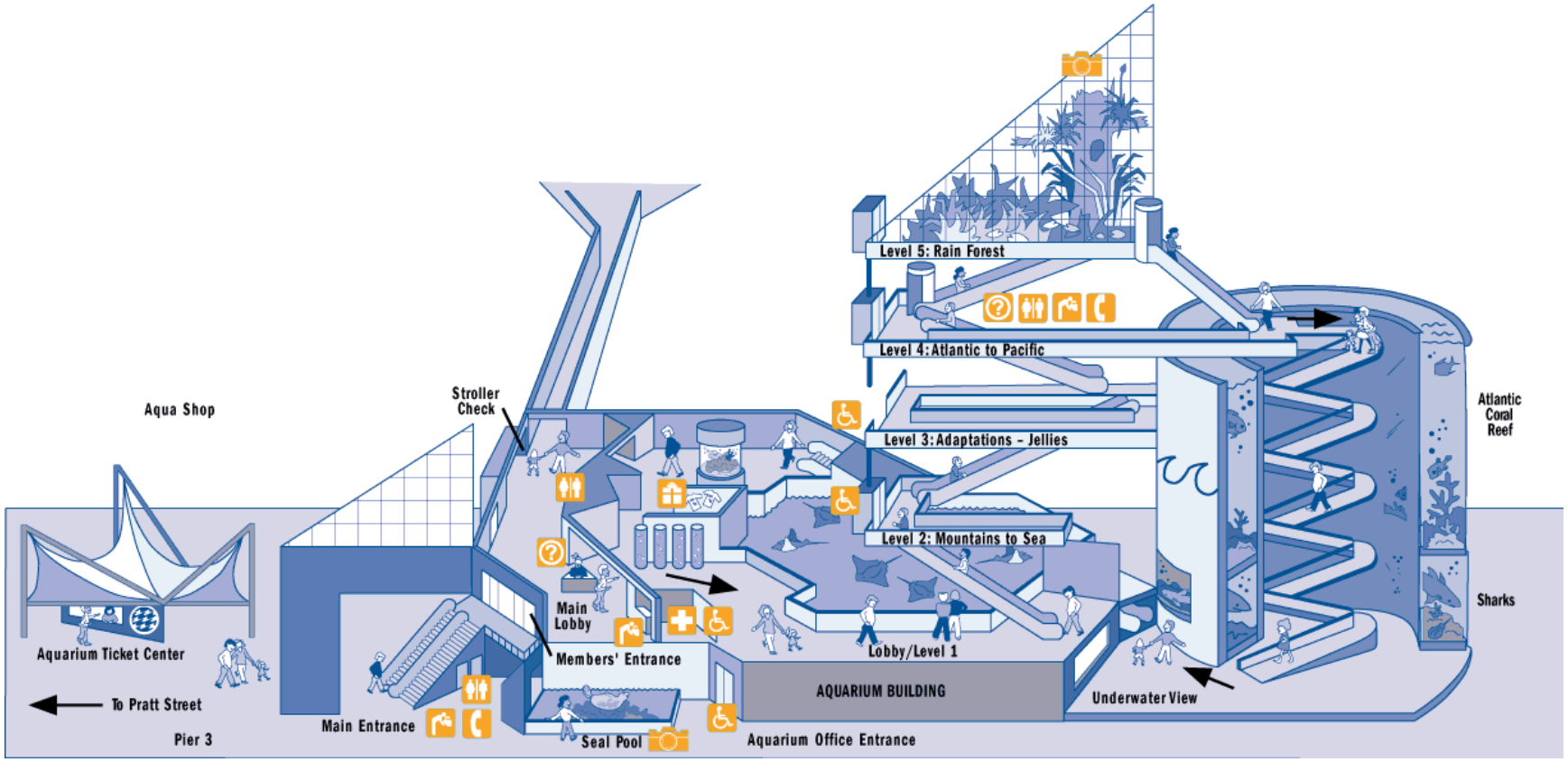
On entering the lobby area the visitor first encounters a water toy, transparent tubes of bubbling and gurgling blue water that screens the if shop beyond and deflects the incoming traffic away from the out bound circulation stream. As the visitor enters the main exhibit area, he then passes in to the silence and the shadows of the underwater world; a soaring cavern crunched with

balconies and docks and rises crossed by up reaching bridges. Just below the bridges one stares into the pond where the dolphins covert. Further across the way dark silhouettes continue to glide sinuously at the eye level, this is the horrifying preview of the shark pool. All around this place are the under water illuminations of the dolphin pool th4e undulating neon lights that warp the ring tank. Inside and outside, and the colorful glow of the surrounding exhibits. These are in turn picked by the reflective surfaces of the ceilings and the under side of the ramps, bounced back to the never still water of the pool, and diffracted into kaleidoscope play of moving light and colors. The visitors continue to follow the upward spiral, through exhibits galleries edging the central space, crossing the void with each change in level.

The flow of circulation is clear but is not insistent. To prevent museum fatigue and to hold on to the spirits of the visitors the upward path progresses along an ABBA rhythm. In this the sensual and the intellectual elements of the detailed exhibits are encountered by the complimentary expansiveness of the space itself. If the visitor is tired physically or mentally he can drop out of the path to loiter in the cul-de-sac or he might ease himself off by just gazing down at the dolphins cavorting in the luminous pool below the bridge. The dolphins at any point form a point of reference before being beckoned onward to glimpse the exhibits around the next bend.

The upward journey terminates into a major suspense in the form of the dense and humid jungle of the rain forest, the visitor descends to the surface of the water in the ring tank and the warp, around the painted horizon, before drifting down thaw enclosing tanks and the depths.

The visitor witness the first mystery of the deep oceans in the form of coral reefs, which's brilliantly, colored inhabitants scoop and dart under the occasional shadow of more formidable fish. The sinister forms of sharks and rays surround descending father down the visitor before moving gracefully onto a lower expanse of the windows looking from underwater to the dolphin pool. The final lap is up to the lobby level, where summary exhibits traces the role of man as explorer and exploiter of the fragile life giving sea.


Level 5: Rain Forest
Level 4: Atlantic to Pacific
Level 3: Adaptations - Jellies
Level 2: Mountains to Sea
Lobby/Level 1
Aqua Shop
Stroller Check
Aquarium Ticket Center
To Pratt Street
Pier 3
Main Entrance
Main Lobby
Members' Entrance
Seal Pool
AQUARIUM BUILDING
Aquarium Office Entrance
Underwater View
Atlantic Coral Reef
Sharks

ANALYSIS OF THE AQUARIUM:

Positive points:

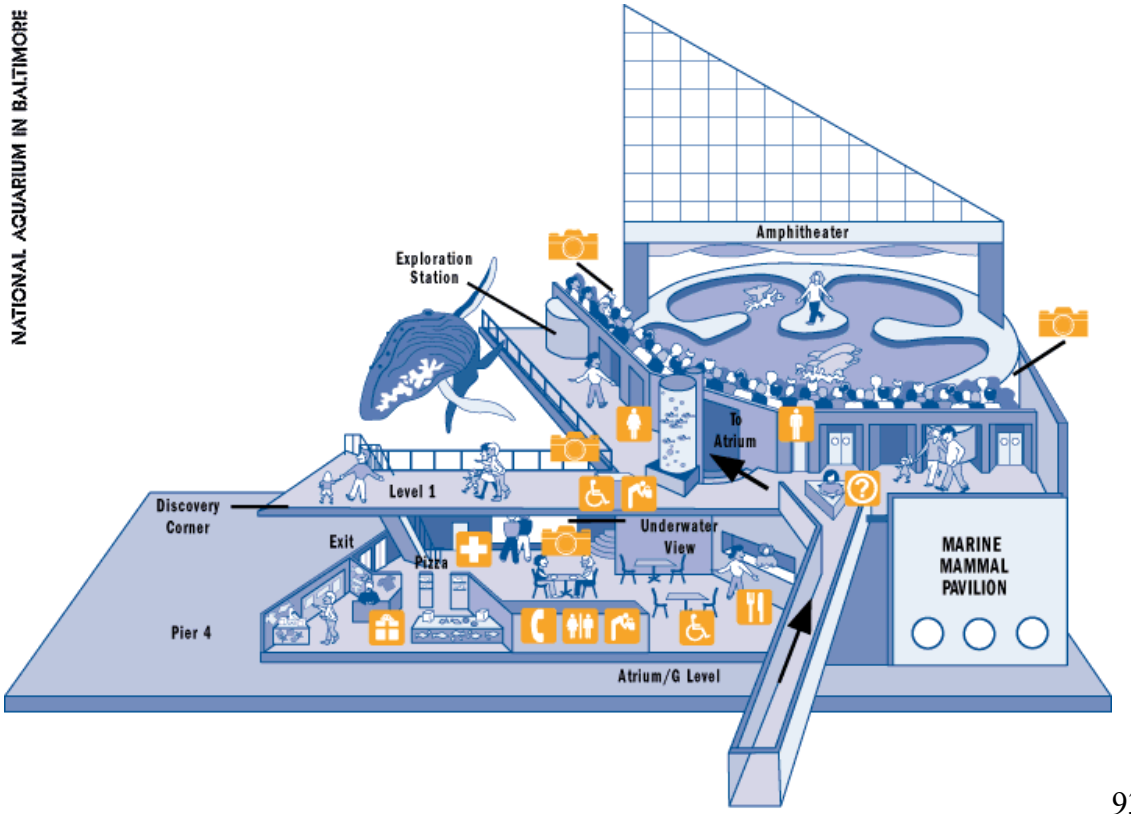
1. In the entire scheme water is used as a main design element, a pond and a stream in the rain forest a water toy screening the gift shop at the entrance etc.
2. The circulation inside the structure being unidirectional, the incoming crowd does not merge with the outgoing crowd and a continuous flow of visitors is maintained.
3. The ABAB rhythmic progression of the tanks i.e. the sequence of smaller tank following a larger tank and than again a larger tank holds the attention of the visitors as it helps to break the monotony of viewing the exhibits.
4. The structure is the combination of different forms but given complete justice as regards to their importance. The exhibit galleries forming a part of the octagon. The rainforest forming a triangular tiara. The descending coral and the shark tanks are oval in shape. The educational area is a triangle.
5. The different sound and visual effects accentuate the movement inside through the exhibits. Thus making the visitor feel the reality inside the space and to make his trip a memorable one.
6. The provisions for the disabled are adequately considered.

Negative points:

1. The structure has a boxy and bulky appearance; does not compliment with the seascape.
2. Even though the structure is dedicated to the ecosystem, it does not show any consideration to nature due to its bulk
3. The site seems to be constrained and overcrowded.
4. The circulation inside the aquarium winds up to the rain forest, which thus gets the most importance and then unwinds down towards the exit. Hence it fails to give the visitor a feeling of traveling through the depths of the oceans.

MAMMAL PAVILION BALTIMORE

PROJECT: marine mammal pavilion,
Pier 4, Baltimore
PROJECT ARCHITECT: Grieves associates,
Baltimore, Maryland
Date of completion: 1992



93.

Categories of major areas:

The dolphin habitat

The curbstone of the new facility this 1.2-gallon pool and 1300 seat Lyn P. surrounding the pool are the world's largest acrylic windows providing the visitors with unprecedented underwater viewing of the marine animals.

Scylla

A life size replica of a real humpback whale Scylla spans two levels of the Helen and merrily bank atrium and is the centerpiece of the pavilions hands on exhibition. Visitors can discover the most fascinating details of this fascinating animal through a series of specially designed view copes located around the perimeter of the second level.

Educational arcade

Boasting a series of customer-designed hands on exhibits the educational arcade enables the visitor to learn first hand about the behaviors and the characteristics of the marine animals. Computers and other technology enable visitors to produce a whale song take photos of a whale fluke and create a whale bubble net among the other interesting activities.

Discovery room

A complete selection of marine artifacts from the shark teeth to the baleen are on hand for the visitor to explore the room the resource center is designed as an aquatic learning center and it features two 1000 square foot classrooms and a lab.

Visitor amenities

The first level features a food service area with comfortable seating and light snacks as well as an aquarium shop complete with the fine gifts, educational materials, and ad souvenirs. Wheelchair access is also provided all throughout the pavilion.

IMAX THEATER,

PORTVELL

PROJECT: IMAX THEATER
PROJECT LOCATION: BARCELONA, SPAIN
ARCHITECT: JORDI GARCES, ENRIC SORIA ARQUITECTES

CLIENT: TEATRO IMAX, BARCELONA SA
TOTAL FLOOR SPACE: 25OO SQ.M.
NO OF FLOORS: 2
TOTAL CONTRACT COST: US$4.5 MILLION
DATE OF COMPLETION: FEBRUARY 1995

The commercial development of Port well marks the latest stage in reclaiming Barcelona's coastline from the industrial wastelands within a master plan jointly drawn by the port authorities and a city hall, a number of new redevelopments are now redefining the water front, among them are the magnum commercial center, an aquarium and a wavy timber decked link. Amid this new collection of buildings, one stark white structure stands out; the IMAX Theater designed by Jordi Garaceds and Enric Soria. In contrast to the sea lapped glass and granite al around it the Imax Theater is clad in white aluminum panels. It emerges in the center of the

port well surrounded by water, an object substantially taller than neighboring buildings and oddly indifferent to its context, like a giant plush cruiser newly moored out at a port and somewhat scornful to the other cart. What makes it work with its surroundings is-the way its decks-the wooden public pathways and thorough fares- draw people into and through to its leisure facilities while providing panoramic view of the sea.

96.

Its form has been based, say the architects on strict functional criteria. The characteristics of the Imax film technology dictated the layout and spatial volumes. The Imax Theater is actually four buildings in one. Three are moderately proportioned (11 meters tall) and are grouped around an entry foyer, an open patio with extensive skylight above. One is an administrative block with ground floor entrance booth and first floor offices; second floor is an administrative block, with a ground floor bar and shop,

restaurant and rest rooms on the first floor, and terrace and balcony overlooking the marina; the third is a service block.

Out of these three ways composition jets the tallest and the most visible element of the project. This is the hexagonal prism of the grand projection room. 26m. high with precisely sloped seats and large screens and space and equipment for the projection and production.

Fit for its purpose and scheme may be but the blank facades and the stark geometric forms of traditional Spanish warehouse architecture has also influenced the white box style of design. Garces and Soria have taken as serious and clinical approach for a building type that often inspires more outlandish imagery. But then the architects were keen to float their own ideas: we wanted the vision of Imax to evoke.

SEA LIFE CENTER, BIMINGHAM.

PROJECT: SEA LIFE CENTER, BIRMINGHAM
PROJECT ARCHITECT: SIR NORMAN FOSTER AND PARTNERS
PROJECT CLIENT: VARDON ATTRACTIONS LIMITED
DISPLAY DESIGNS: VARDON ATTRACTIONS
QUANTITY SURVEYOR: GEOFFREY NICHOLAS ASSOCIATES
MANAGEMENT CONTRACTOR: TAYLOR WOODROW
VISITORS PER DAY: 8,000
VISITORS PER YEAR: 3,00,000
DATE OF COMMENCEMENT: SPRING 1995
DATE OF COMPLETION: SUMMER 1996
BUDGET: 2.57 MILLION POUNDS

INTRODUCTION

The new sea life center in Bindley palace Birmingham opened in July 1996 is Britain's first major aquarium in the city and houses the biggest collection of both native fresh water and marine creatures in Europe including sharks, stingrays and eels.

The buildings shape has been derived directly from the marine exhibits themselves, the sweeping structure being modeled on the profile of a ray. The gross external area of 4032 sq, m. and net internal area of 3600 sq, m. includes exhibition space, retail, catering and educational facilities and fit out designed by Vardon Attractions.

A faceted solid wall facing the canal is expressed as an articulated plane by recessing the glass stairs at each end. The roof is articulated from the walls with a narrow glass slot and blue painted steel works. The walls are silver metallic finished steel panels with glass or louver in filled where required a pre cast concrete base warps around the building providing a tough external surface which takes up the differing ground levels and the

gradients. The roof has a double curvature and is finished in a mid gray polymeric material.

Two lifts convey visitors to the lower found /canal side level from which they enter the main tank containing over 825,000 liters of water. A curving acrylic tunnel turns into a unique 360n degrees transparent viewing tunnel offering an unparalleled aquarium experiences with the water and marine life on all the sides above and below a vertical tunnel at the exit of the display area allow another glimpse of the feature tank, while a further porthole on the external wall to the canal offer glimpses into the tank from outside. Glass slots in the stairs and glazing in the temporary exhibition and café area further animate the building.

The aquarium exhibits are laid out in a sequence of displays accessed by a ramp and lift and mostly contained within the single space of the building. Starting at the ground level with examples of marine life in a harbor environment the exhibition moves on via ramp onto the beach display including dunes and moving waves. The shoreline display on the first floor surrounds a virtual reality room, which forms part of the team that organizes the educational program. The tank offers the opportunity for visitors to make safe contact with marine creatures at feeding time and proceeds the sea lab where under trained supervision visitors can learn about and interact with the creatures.

The ramp up to the second floor offers visitors a chance to look back down at the ground and first floor displays and the sidewalks into the tank of marine life en route. Fresh water displays are arranged in the second floor including cliffs, streams and reservoirs ponds and a canal feature. An open balcony provides a breathing space before the riverside exhibits and brings people back to the daylight. The level change between ground level at Brindley palace square and the canal side offers the opportunity to enter the aquarium at both levels which maximizes public access to the facilities and potentially animates the surroundings. For example the café spilling out into the canal side area. Facilities, which are public ally accessible without payment, include the foyer with entrance displays, a temporary exhibition area, café, shops and toilets all of which have level access from the outside.

The site enjoys a prominent waterside location at the northeast corner of the mixed-use Brindley palace development and is at the junction of the Birmingham canal system usefully underlining the water scheme. Directly opposite is the national indoor arena and near by are the international convention center and the symphony hall.

In addition a new light weight steel bridge links the Brindley palace development with the national indoor arena and a proposed housing development to the north west improving pedestrian access to and from the site especially for the disabled further external works have been designed with a landscape architect and are compatible with the rest of the Brindley palace development.

ROOF

Steel works;

The roof is a doubly curved surface from a series of curved preliminary beams. Each of these primary elements is curved to the same radius. One end is anchored at the nose of the building and the other sweeps through the arc of a vertical circle to produce the double curved surface. Secondary beams of varying lengths span between these primary elements to support the roof deck.

DRAINAGE

Roof drainage

The roof is drained from two points. The double curvature means that the front face rain have to be drained out through the balcony via hidden rain water posts while the main surface and is drained outlets are located to displace the water via two rainwater pipes either side of the entrance doorway.

EXTERNAL WALLS (including windows and doors)

External vertical cladding
(Solid areas)

The primary external cladding system comprises of a steel composite of an external panel fixed to internal surfaces where necessary.

The building sits on a precast concrete panel clad plinth that is fabricated to match the cladding system in the appearances of the joints; color and texture.

The building is designed on a 3.26m. By 1. Planning module faceted around the canal edge with a floor dimension of 3.1m.

Curtain walling will comprise of an aluminum panel fully thermally broken, pressure equalized and self draining; mullions and transoms formed from extruded aluminum with all visible surfaces, silver metallic finish; double glazed throughout.

IBARAKI NATURE MUSEUM;

PROJECT: IBARAKI NATURE MUSEUM
LOCATION: IWAI CITY PERFECTURE, JAPAN
ARCHITECT: MITSURU MAN SENDA AND ENVIRONMENTAL DESIGN INSTITUTE
INTERIOR DESIGNER: MITSURU MAN SENDA AND ENVIRONMENTAL DESIGN INSTITUTE
CLIENT: IBARAKI PERFECTURAL MUSEUM
TOTAL FLOOR SPACE: 12,771 SQ.M.
NO OF FLOORS: 3
TOTAL CONTRACT COST: US$194 MILLION
DATE OF COMPLETION: NOVEMBER 1994

Birds flying across
The surrounding marshlands
Become the principle exhibit
In this interactive museum of nature,
Shaped like a pre-historic beast
Lying low in the trees

An hour's drive from Tokyo, the Ibaraki nature museum has been built beside the marshlands of Sugao. A series of swamps and draining to the Tonkawa river, as a very deliberate and successful exercise harmonizing architecture with nature the size of the building, just 16.4 hectares is dwarfed by the vast 230 hectares lake besides and there are stunning views across the plain. In this museum the main exhibit is mainly the marsh outside with its flock of migrant birds skimming in the water.

The purpose of this well composed user-friendly complex is environmental and ecological education. It has been signed to stand higher than the surrounding woodlands. Its surfaces are covered with large earth colored tiles; a bulk has been broken down into five separate sections or pods that run off the central spine. Sitting on its green context, these vertebrae help to give the building the abstract look of a prehistoric creature; the head close to the lake contains the entrance, the restaurant and an audiovisual reflection hall. Trees surround the main body of the building.

The brief specified two requirements:
First a joyful nature museum and second a facility for families to cultivate environmental literacy. So this is very much hands on, interactive museum, with play equipment, a fresh water aquarium and an external discovery plaza on a hill, where children can experience the excavation of the fossils, all contributing to the sense of engagement. Six different exhibition themes are accessed from a central spine in such a way that the architect likens the plan to reading the chapters of a book.

The largest exhibition hall sits next to the lake, providing fine natural views from the various levels. Including a bird watch cage on the second floor. Discovery and enjoyment are the keynotes of the Ibaraki museum experience. But in the quest to entertain and amuse this is a facility, which never trivializes its subject matters. Indeed, it is clever appropriation of the surroundings marshland for exhibition purpose is achieved with simplicity and restrain.

OCEANS PAVILION
PARQUE DAS NACOES

PROJECT: OCEANS PAVILION, LISBON, PORTUGAL
PROJECT OWNER: PARQUE EXPO ‘98
ARCHITECTS: CAMBRIDGE SEVEN ASSOCIATES
ASSOCIATE ARCHITECT: PROMONTORIO ARTCHITECTOS ASSOCIADOS
ENGINEERS: OVE ARUP AND PARTNERS
DESIGN/BUILD/STARTUPS: IDEA/ENGIL
HABITAT BUILDER: DAVID.L.MANWARREN
PROJECT AREA: 215,000 SQ.FT. FOUR STOREY EXHIBIT AND MAINTAINENCE SPACE TWO STOREY ACCESS BRIDGE. ONE STOREY SUPPORT BUILDING
COST: $ 70 MILLION

147.

A single idea that all of the world's oceans form one great sea. , the theme and unifying element of the oceans pavilion a primary attraction at Portugal world expression _ expo 98 a huge, 1.22million-gallon tank 110 feet square and almost 110 feet deep, lies at the heart of the pavilion, informing the architecture and organizing the aquarium around the central concept; the inter-relationship of global waters.

This force coincides with that exposition theme; the oceans- a heritage of the future.

The new aquarium, Europe's largest, offers an emotional experience that's more theater than science. Peter Chemayeff of Cambridge seven associate, which designed the aquarium says,' the oceans pavilion may provoke controversy among those who will say this isn't a strictly scientific presentation. But there shall also be those who will say:' yes, this is scientific. It makes a point of the unity of the earths oceans.

148.

The aquarium as a theater

As in contemporary theater the interior architecture is intended to disappear, focusing attention on the fritted glass provides different light levels at each corner of the building after a complete tour of the upper zone the path drops one level to the ocean floor for submarine views of the four ocean, as well as the sharks, rays, sea turtles, mackerel and other creatures in the main tank. Altogether there are 8000 specimens and 250 different species swimming in 1,56 million gallons of ocean water.

The lines between underwater life and the human realm are blurred. Remarkable optics, heightened by controlled internal lighting, allow clear views through the 12 to 14 inch thick acrylic walls. As a result, fish from opposing oceans seem to coexist in a single visual field. The effect is surreal cold water sharks seem to glide by tropical fish in a seamless dance.

Plagues and description of the marine life have been kept to a minimum the pavilion is not overly didactic. Instead visitors experience the marine species in a series of meeting places in the contemplation rooms- quieter, more intimate spaces with smaller focused views, located on the lower level- visitors concentrate to watch music.

Visitors come and go via a covered ramp, a dual level bridge that connected the water surrounded aquarium with its land-based sister building. Ticket sales are housed there along with the shops, offices, galleries, and a conference area. Lining the long high wall that organizes the support building is Ivan Chemayeff's giant mural of ocean life. High and low tech combine in the mural, which uses 60 variations of hand painted blue and white Portuguese tiles to maintain the computer screen pixels.

149.

CREATIVE CONSTRUCTION

The $70 million oceans pavilion had an unusual genesis, the result of a unique design and construction collaboration that extends the understanding of the term design build. Chemayeff also serves at president of IDEA INC. a separate company that provides turnkey services beyond architectural design. IDEA produced feasibility studies and oversaw exhibit planning construction, staffing, and training for aquarium and even the choice of sea creatures. The partnership of IDEA and ENGIL set the budget and guaranteed a fixed price for construction.

According to Peter Sollogub, Cambridge's sevens principal- in charge who worked on the project from the beginning, construction was complicated by the work habits of the Portuguese. Which are different from those of the American builders.

“They don’t really use shop drawings in Portugal”, he says,” This is a product of handicraft”. But the team product the project within the budget, and the aquarium was one of the first major structures ready for explosion, which opened its gates in May.
Following the world exposition cruise, projected to reach a peak of 80,000 visitors per day, the pavilion will be renamed the Oceanarium de Lisbon and the remaining open as a public aquarium. One million people are expected to visit every year. Other significant infrastructure that will remain after the exposition closes in September include a 840 acre urban development project called EXPO URBE, which combine 1,850 residential units, hotels, and office development, rail lines, including a station designed by Spanish architect Santiago Cxalatravea and a bridge across the Tagus river should encourage new horizons for Lisbon and for Portugal.

 150.

GENERAL VIEWS WITHIN AND OUTSIDE THE PROJECT

SEA WORLD, FLORIDA

PROJECT: SEA WORLD FLORIDA
PROJECT ADDRESS: SEA WORLD-ADVENTURE PARK
7007 SEA WORLD DRIVE
ORLANDO
FLORIDA 32821
U.S.A.
SITE AREA: ABOUT 50.5 HECTARES.
DATE OF COMPLETION: DECEMBER 15, 1973.

128.

The sea world is concerned as an adventure park beautifully landscaped to incorporate many different themes into the same site. It gives the visitors a full-fledged educational, tour warped in an exciting package. The main areas of the park are as follows:

1. Stadiums

2. Pools
3. Themed areas
4. Sky tower
5. Theaters
6. Restaurants

STRUCTURE

The park is designed in such a way that it has a number of buildings, which express different themes. The main attraction is the one million gallon salt water performing pool with 3000 seats in air-conditioned stadium for the killer whale shows and 61850-gallon salt-water pool for seal and otter shows seating an audience of 3000.

The fiber glass used in various aquaria where the observation panels are included viewing panel ones or laminated temperate glass depending upon the size of the pool or the aquaria. The glass ranges from 15mm to 250mm in thickness. The animal housing duplicates to the maximum extent as possible the natural habitat of the animal can be seen in the photos.

Following below is the list of the various areas inside the park-

STADIUMS

Shamu stadium
Sea lion and the otter stadium
Atlantis bayside stadium
Key west dolphin stadium

POOLS

Manatees- the last generation
Pacific point reserve
Key west at sea world

Stingray lagoon
Tropical reef
Dolphin nursery
Turtle point

THEATERS
Sea World Theater
Nautilus Theater

THEME AREAS
Terrors of the deep
Wild arctic
Bird garden
Penguin encounter
Journey to the Atlantis

RESTAURANTS
There are in all around 8 dining areas with different specialties well spread over the entire site

OTHER FACILITIES
Hospital center
Arcade
Games area
Children's play harbor
Private parties pavilion

Terraces
Gift shops
Foreign currency exchange
Pet care facility

The park has a special feature
FANTASY FOUNTAIN THEATER

This consists of water and a synchronized fountain to the music. Decorative lighting projected slides and movies in theater atmosphere. It is a computer controlled show and the seating provides for an audience of 900 people. The entertainment concept consists of marine animals performing in themed scripted shows and water skies shows one-admission fees covers all the shows, exhibits and parking fees. The visitors can choose their own sequence of viewing the displays.

The sea world park arranges guided educational tours throughout the sites for schools and colleges. It conducts rescue tours to natures rescue threatened animals. The park offers additional facilities like having dinner with the sharks, arranging a company picnics for groups at its unique venues, world class cuisine, private party and rock night shows with the evenings lit with awesome display of fire works and lasers. It arranges for children's birthday parties with aquatic themes.

The park has free and open circulation. The pathways wind around different structures giving an informal feeling to the park.

Some negative aspects are that the people have to view the exhibits from the windows and are not surrounded by the sea therefore one does not have the feeling of viewing the deep-sea animals.

The theme of the animals shows is for the purpose of entertainment, it serves more as a circus and not for the purpose of exploration and discovery.

Ocean park is a feature rich park with a great diversity of marine and other animals and is topped with a generous serving of good entertainment.

133.

OCEAN PARK HAS MANY THEMED PARKS

A Chinese butterfly display
Wildlife faculty
Dolphin University
Lowland gardens
Goldfish pagoda
Atoll reef
Wave cove
Aviaries

134.

OCEAN PARK LIVESTOCK SUMMARY
Flamingoes-37

Butterflies-3500
Other birds-2000
Penguins-14
Sea lions-14
Fur seals and seals-5
Swans-14
False killer whale-1
Dolphins-11
Shark and rays-250
Marine fishes-3000
Goldfishes-800

135.

ATOLL REEF

Dimensions 22m

Depth of the tank	38m
Depth of shallow section	7m and 2m
Depth of shallow section	4334 and 300 gallons

Total water capacity of both 100 pieces each comprising 3 layers together with a total thickness of 6cm, which can withstand pressure of 50,000/cm water from the main reservoir replaces 5% of water in the atoll reef everyday and recycles every 11/2 hour.

Visitor capacity	600
Number of fishes	5000
Viewing galleries	1 upper gallery, 3 underwater galleries

OCEAN THEATER

Seating capacity	3500
Dimension	53m x 53m x 6.3m deep
Seawater capacity	4,5 million liters
Temperature	22 to 24 degrees
Recycling time	31/2 hours
Daily fish food	80-100 kg
Performing animals	killer whale, sea lions, dolphins

WAVE COVE

Dimensions	50m long 35m wide
Depth	2.7m
Water capacity	1.5 million liters
Water recycles	every three hours
Performing animals	seals and lions

CABLE CAR SYSTEM

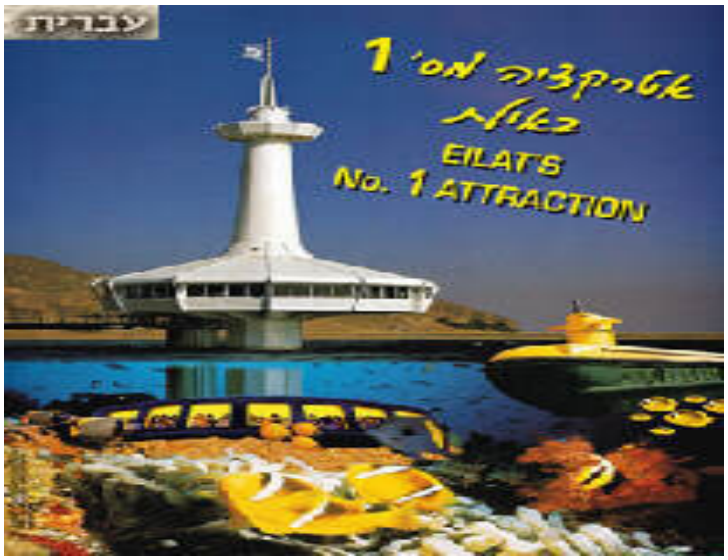
137.

THE UNDERWATER OBSERVATORY MARINE PARK

Address: Coral World Eilat
P.O.B. 829,
Eilat 88106
ISRAEL
Tel-972-7-636-4200
Fax-972-7-637-3193

LOCATION

The underwater observatory marine park is located 7 kms south of the city of Eilat and can be reached either by the Eilat municipal bus no 15, a short taxi ride or the super ticket cruise.



138.

Opening hours

The park is open daily including Saturday from 08.30 until 17.00 (summer) or 16.30 (winter). On Fridays and holiday eves, the park is open until 15.00

Prices and fees

	Adult	child
Park entrance	63NIS	45NIS
Entrance+oceanarium	76NIS	58NIS
Entrance+oceanarium+submarine	268NIS	158NIS

THE YELLOW SUBMARINE

The yellow submarine dives at the following hours

Mondays/Tuesdays/Wednesdays and Thursdays: 09:45, 11:00, 13:00, 14:15, 15:30.
Sundays: 09:45, 11:00
Fridays and holiday eves: the last dive is at 14:15.

Reservations can be made over the phone at 972-7-636-4200.

Minimum age for the passengers: 4 yrs

THE SUPERTICKET CRUISE

The underwater observatory marine park can be reached by road or via sea, via the cruise on the glass bottomed coral pearl from the Eilat Marianna directly to the dock of the Park. The boat will take you along a beautiful coral reef revealing a magnificent view through its glass bottom. Apart from an entrance to the park the super ticket package includes any combination of cruise, either to or from the park or both, with the option of a dive in the yellow submarine.

CONCEPT

The oceanarium is an edutainment attraction, and is designed for family recreation, offering both youngsters and adults the fun, excitement and enriching experience of the wonderful underwater world. The oceanarium is the first site worldwide to offer a solution that monitors seat movement from different ages, thus allowing even the most timid to take part in this amazing experience, all those who are young at heart can enjoy a more powerful gut-wrenching experience of motion. In the initial stage, the oceanarium is presented to the audiences in Eilat in two languages-English and Hebrew, one language coming over the loudspeakers and the other heard through special headphones.

Additional languages will be added at a later stage. A multi effect experience: the oceanarium experience affects many senses and is composed of the following elements.

1. A high quality movie projected on three large scale screens (4 x 18m). Viewers enjoy a sea-scape that envelopes them from right to left, and thus feel in the midst of this underwater view.
2. Moving seats that tilt in all directions, according to the motion of the submarine in the movie
3. A computer program that co-ordinates the movement of the seats with the movement of the screens.
4. Several high power and sophisticated amplification systems.
5. Special effects

THE UNDERWATER OBSERVATORY MARINE PARK

The oceanarium designed by Dov Ben David. The three screens at the fore front of the hall depict to the audience the occurrences and developments outside the submarine and within the captains cabin. The hall itself is decked out as the impressive interior of this strange submarine undergoes during the journey the ceiling comes down, water enters the hall, and many other Impressive effects occur.

STRUCTURE:

The oceanarium structure was de signed by architect Haim Lotner, of the Lotner-Bergman architects' agency in Jerusalem. Har Kal served as the projects head-executing officer.

PROJECTORS

The movie is projected via three large projectors manufactured by the Israeli company Unic View. TILTING SEATS the seats are installed on special platforms that are moved by hydraulic axles, allowing for motion in several spheres. The viewers are safely secured to the seats that are installed in the platforms. The safety means comply with the most stringent standards and include the following:

1. Safety belt. The platform rotation is discontinued immediately in the event that one of the viewers belt is opened.
2. Safety valves, designed to automatically stop the rotation of the platform in the event of a malfunction.
3. Manual emergency brake that stops the platform.

SUBMARINE:

The yellow submarine, "JACQUELINE" is an exhilarating, unique experience, which should not be missed. This submarine dives at a depth of 60meters, which is a depth, which unto now only divers knew.

AQUARIUM MUSEUM:

The aquarium museum has 38 different sized aquaria holding over 500 different species of coral reefs, fish, sea sponges and marine invertebrates found in the Red Sea area. Each aquarium provides a naturally balanced habitat for the marine creatures it houses, including a large dark aquarium to show the beauty of the flashlight fish. The entrance foyer of the museum presents an exhibit of marine life fossils collected in the area.

144.

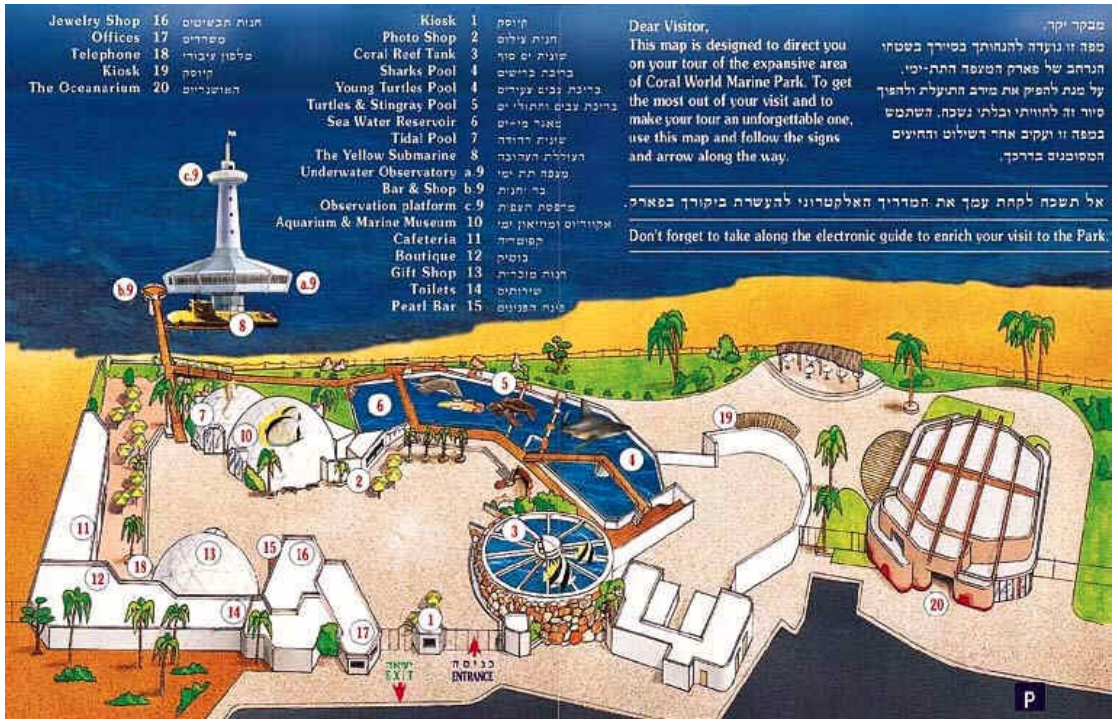
TURTLE AND STINGRAY POOL

The turtle and stingray pool complex comprises of two pools. The lower pool, which holds stingrays and adult turtles, has a central sandy specially, designed to serve as the turtles laying area and during the summer breeding season.
The underwater observatory marine park is the only institution, worldwide, which successfully breeds and rears hornbill turtles in captivity. When the turtle eggs hatch, the young are removed to a special adjacent aquarium. At a later stage, the juvenile turtles are brought back to the complex and can be watched swimming in the upper pool.

Apart from hornbill turtles, there are three species of stingrays, which can swim at the bottom of the pool and can be hand-fed.

145.

AN OVERALL SKETCH VIEW



VIEW FROM ROAD

146.

VANCOUVER AQUARIUM:

INTRODUCTION

The Vancouver aquarium in Stanley park has grown from a modest building exhibition a hunted selection of selected aquatic communities to one of the largest and most influential institution of its kinds.

Its live collection exceeds 5,500 specimen and includes mammals, reptiles, birds, amphibians, invertebrates, and fishes.

98.

The original building opened in 1956 with major addition made in 1967. The aquarium is operated as a non-profit private society under the direction of a 36 member voluntary

board of governors. Additional part time personnel supplement a permanent staff of 55 members during peak attendance. The clamshell gift shop that is operated as a departmental store within the aquarium has earned itself a reputation for carrying high quality merchandise, books, and exclusive products. All profits from the gift shop remain in the aquarium for operating expenses.

AIM AND OBJECTIVES

Canada's Pacific National Aquarium is dedicated to the effecting the conservation of aquatic life through display and interpretation, education, research and direct intervention. The aquarium is dedicated to conserving whales in the wild through education and research, and is committed to providing the best care possible for the individual whales in the aquarium.

MAJOR EXHIBITS

The major exhibits can be mainly divided into two zones:

1. Outdoor exhibits
2. Indoor exhibits

OUTDOOR EXHIBITS

ARCTIC CANADA

The creek of the ice and the eerie language of the whales surround you as the visitor submerges into the underwater viewing gallery in the cold blue world. One comes face to face with beluga whales and the underwater world of the arctic Canada.

SEA LIONS

The boisterous sea lions at the Vancouver aquarium are a part of a special research project designed to uncover the answer to the challenging question regarding the disappearance of the stellar sea lions. Besides the aspect of entertainment, the visitor can also get involved himself in researching in this field of sea lions.

THE PACIFIC NORTHWEST

A wealth of life inhabits the local waters of Canada. The visitor is able to take a underwater view of Canada's richest treasures-a flourishing North Pacific Kelp Forest. One is expected to find playful others busily clean their fur, octopus glide from crack to crevice and the awe-inspiring killer whales. Scuba divers feed hungry halibut and harvest fast growing kelp.

INDOOR EXHIBITS

THE AMAZON RAINFOREST

This exhibit consists o f a replica of the Amazon rainforest where the worlds largest fresh water live. It occurs first as one enters the indoor exhibits. Scarlet ibis and sloth are a part of the recreated jungle. An artificial environment is created using the high tech graphic and innovative light and sound effect to give the effect of dark clouds, rumble of thunder and artificial rain. Thus a visitor can learn through fun, how animals react as they sense the approaching storm.

THE INDONESIAN REEF EXHIBIT

In this exhibit one step inside a living rainbow, Indonesia's Bunken National Park. The world famous dive sites are recreated behind a floor to ceiling panoramic window. One can spot brilliant angelfish dart off cover in the reef.

TROPICAL PACIFIC GALLERY

Tropical coral reefs, which are the most colorful places on earth are found sharks and an array of coral reef fishes live in the tropical pacific gallery. The elusive giant pacific octopus marks the start of a journey amongst a variety of fishes, invertebrates and habitats.

GIANT FISHES OF THE AMAZON

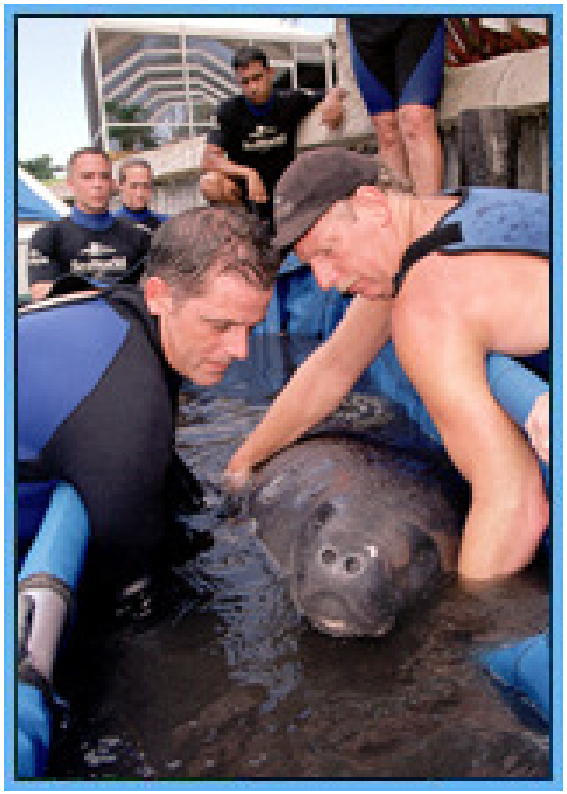
In this part of indoor exhibits the visitor discovers the impressive giant catfish and other giant fishes from the flooded forest. A visitor is able to find out how these are connected to the survival of the Amazon forest.

WATER SUPPLY SYSTEMS

Water from the aquariums seawater exhibits comes from the Burrand inlet through a water pipe, which is 610m long, and 30 cms in diameter. Unfiltered seawater from the seawater intake supply systems enters the aquarium building an discharges into gravity sand filters. Particulate matter is removed so that the clarity of the seawater is sufficient for underwater viewing. The filtered water is distributed to all seawater exhibits in the aquarium building. At any time there is a total of 46,94,000 liters of seawater.
Typical, a tropical seawater recalculation system of a clean water from the reservoir and the pumps it to the display tanks: the display or pools: a recalculation header and a drain header and a biological or slow sand filter.

SPECIAL CARE FOR MARINE MAMMALS:

Seas water used for whales, sea otters and seals is filtered through vacuum P.E. filters. Whale pools have a small amount of chlorine and copper sulphate added to sterilize the water, while the sea otter and seas pools have their water treated with chlorine, which is removed, before it returns to the exhibit pool. Water moving sat the rate of 52,87,4500 liters per day is the basis of the aquarium life support systems. Its care and quality control is vital to the health of all the aquarium animals.

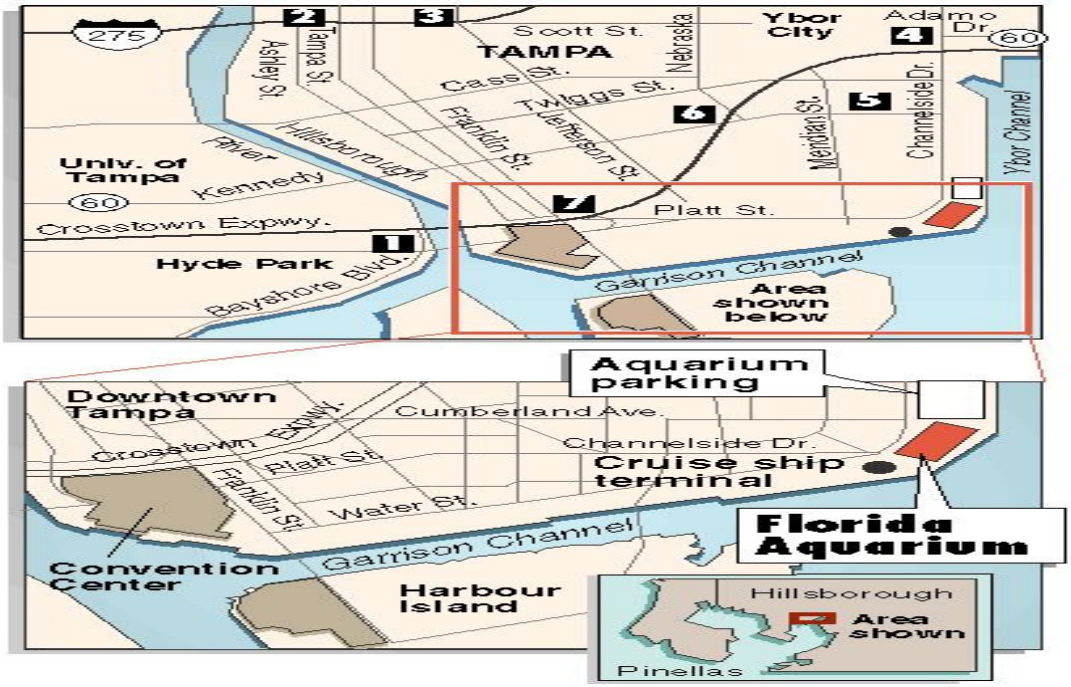


Area analysis:

Total building area	72090sq.m.
Public viewing and circulation space	19%
Exhibit spaces	23%
Life support system including mechanical	
Plumbing and electrical systems	11%
Administration and library	08%
Research and education spaces	06%
Gift shops and storage	06%

THE FLORIDA AQUARIUM

PROJECT	The Florida Aquarium
ADDRESS	Florida Aquarium Tampa, Florida, USA.
ARCHITECT	Hellmuth, Obata and Kassabeam (HOK).
PROJECT AREA	3 Levels—52000sq.ft.
SITE AREA	More than 4 acres
PROJECT COST	$ 84 Million
STRUCTURE	Clamshell like glass paneled dome. Steel and glass are the chief materials used.



LOCATION

The aquarium is located on Tampa's waterfront in a gritty industrial area that had deteriorated over the years. It offers a look at the diversity and the beauty of the states of the states aquatic habitats right from the wetlands, bays beaches, to the coral reefs and also the offshore ocean depth.

KEY IDEA

It was conceived as a joint public- private project that would act as a catalyst for development of the surrounding area. The key part of the project was to tell the story of the Florida's water, from its underground source to the open sea.

Long before hiring any architects, the non-profit organization behind the aquarium had exhibit designer Joseph Wetzel working out ways to turn an environmental message into an entertaining and educational experience. The project has now, established itself as a signature icon of the area, as it glows from within towards the brighter sky.

DESIGN PROCESS

The building, according to HOK, was designed from inside to outside. They started with the exhibit concepts and then designed the architecture around them. With two architectural firms and the exhibit designer working together and throughout the project, the building is the result of dream collaboration. The project represents the 3rd and the latest wave of the aquarium designs.

It gives the visitors the feeling of being immersed into the aquatic world on the display.

THE INTERIORS

The building is designed, to give the visitors, the scene of being immersed into the marine world on display. The immersion begins with the very first exhibit. After climbing the building's main stair, from a spacious entry hall on the ground floor, the visitors learn about the underground sources of Florida's water while inside a cavern like exhibit. To heighten the sense of being surrounded by the marine world, the designers placed a fresh water spring above the visitors as they move through this exhibit. The thickness of the panes of clear acrylic used here ranges from 1-½ inches to 1-¾ inches. A meandering path then leads to the airy wetlands exhibits, housed with a giant segmented dome of 1,100panes of glass and epoxy coated steel trusses, tubes and cross-bracing. First sketched by the chairman of the HOK, as an abstract seashell, with a radius of 135 ft. and a clear span of 65 ft.

Above the second floor, the dome is the aquarium's most recognizable feature. As the visitors move, from fresh-water exhibits, to the marshes and the salt-water displays, the path slowly so that the water level seems to rise. Leaving the domed portion of the building, one is plunged into the darker realms, where fish swim on the same level as people walk. Most of the aquarium's salt-water exhibits reside in a brightly colored, poured concrete structure on the opposite side of the entry hall from the dome. An outdoor deck outfitted with railings made of nautical piping provides a welcome place to rest, before tackling the remainder of the displays. The star attraction of the second half of the aquarium is the coral reef exhibit, which stimulates a dive into the unique habitat off Florida's coast. The sloping exhibits path winds down and around two giant tanks, offering views of the reef, from a variety of vantage points and depths.

106.

The grand finale is the 43 ft wide, 14 ft high window onto the bottom of a 600,000-gallon tank. The acrylic here is 11 ¾ inches thick. The architects have kept the building cost down, by bringing certain functions outdoors. Certainly, some dining, exhibits and social gathering areas were taken out on the decks and the terraces rather than indoors. The multi-level decks offer views of the water and downtown Tampa on the opposite side.

The main lobby is a 2 storied space, providing access to a restaurant, a gift shop, and multi purpose room on the ground floor. An oval shaped gallery above connects the coral reef exhibit with the domed wetland areas and the bay and beaches displays. The gallery also provides access to an outer deck, where visitors can take a break between exhibits.

LIGHTNG AND SPECIAL EFFECTS

About sustaining light

Many aquatic habitats, particularly wetlands, are fragile ecosystems sensitive to the environment factors such as light. The glass dome admits enough daylight to support the growing organisms in the wetlands portion of the aquarium, where a wide range of plants and animals freely thrive and roam throughout the exhibit area. Since other exhibit spaces required electric illumination in this 3 storied building the lighting design team worked with the curators of the aquarium for 5 years to develop a lighting design that would be most sensitive to the plants and the animals. A key part of achieving this was to provide interior lighting programmed to dim and brighten on a schedule to mimic natural levels of illumination at various ties of the day. At the same time the interior lighting creates a romantic quality that stimulates the mysteries of the deep that the people expect to see in an aquarium.

To create the vivid glow at night, the lighting design team illuminated the dome itself with six 1000watt metal halide flat beam floodlights equipped with the blue diachronic filters for the long life color maintenance. Early in the evening, the resulting rich blue glow is enhanced with the warm tones of

the exhibit lighting within, which varies in intensity as the exhibit cycles dim for mood as well to promote natural cycles for animals later in the evenings. To punch up the lighting during the day when it is cloudy, the designers used metal halide directional accent lamps in the key areas. These lamps are mounted to the structure overhead and positioned over the walking paths surround the exhibits for ease of access, rather than over the exhibits themselves.

SETTING THE MOOD

To provide flexibility in light levels in the Wetlands and Bays and Beaches exhibits, as well as to establish appropriate aesthetic moods, the lighting designers used PAR64 halogen lamps, some of which are equipped with lavender diachronic filters to stimulate a twilight atmosphere. These lamps provide focused illumination in warm tones and a variety of beam patterns. Programmed to maintain long life as well as to bring out the natural textures of the environment, the lamps were aimed to focus light on the exhibit areas rather than on the walking paths, which are lighted with enough ambient and reflected light to ensure safety.

To light the smaller tanks in the underwater Coral Reefs and offshore exhibit areas below, the lighting designers used hidden fluorescent strips with tubes of color to set the mood and provide a counterpoint to the diffuse light with narrow beam 175-250 W metal halide lamps. In the larger deep-water tanks, specialty 1,000W compact source iodide fixtures were used in the foreground to create piercing dramatic light near the viewing windows while the background recedes to enhance the sense of mystery. The fixtures provide a strong beam that punches through 26ft. water to create lighting that stimulates sunlight or moonlight depending on what you put in front of it. The designers also used smaller 175-250W metal halide lamps for accent lighting. To enhance the mood along the pathway, the designers also created a custom fixture featuring motorized lenses coupled with 75W MRI 6s to protect an effect that stimulate rippling dappled sunlight underwater.

Throughout the aquarium, outdoor wet-location fixtures are used to guard against the corrosive nature of the salt-water environment.

COST OF THE PROJECT

Financed with an $84 million bond issue and developed by Kajima International the aquarium is a hybrid public private project. The $ 89.78 million construction budget included $6.8 million for exhibits and resulted into a per sq.ft. Cost of $268 significantly below the $825 to $400 cost of most of the other aquariums today.

SYDNEY AQUARIUM

PROJECT	Sydney Aquarium
PROJECT ADDRESS	Darling Harbor, Sydney, NSW 1230
ARCHITECT	Diane Bernstein and Phillip Richardson
CLIENT	Gurney Holdings.
DATE OF COMPLETION	1988
PROJECT SIZE	2355sq.m. And 2 oceanariums each of 760sq.m.

STRUCTURE

Steel frame, pre-colored corrugated includes walls and roof. The oceanariums have plate and fabric roofs**.**

LOCATION

The aquarium is located at the Darling Harbor, opposite to the Maritime Museum. The aquarium differed in two fundamental aspects from the majority of development in the Darling Harbor redevelopment. The client Gurney Holdings Ltd., having been in the existing original master plan expected to be government funded, essentially privately funded it. It focused on the activity below be water rather than the top, and in that aspect it differed from the earlier proposals for the building.

It did however fit in the basic objectives of the master plan. Thus an above the ground building has been developed with the form that counterpoints the National Maritime Museum on the opposite shores, thus giving

expression to the gateway into the Darling Harbor. The exhibitors collected the most comprehensive and diverse range of aquatic species available.

BUILDING

The building design equally addresses architectural image, educational experience and recreational enjoyment such that all objectives of the building are for. The building has three main components.

THE OCEANARIUM—these are three huge oceanarium tanks located on the north of the main building. These floating semi- submerged oceanarium tanks are provided with an underwater circuit and are the focus of the exhibition.

SUPPORT FACILITES—ALL the support facilities, such as the workshops, laboratories, offices and filtration system are located on the maritime services board wharf no. 10, to the north of the main building.

DESIGN CONDENSING CONCEPT

Two essential aspects of the design concept:

The aquarium is partially submerged, so that the visitors obtain a real experience of marine from underwater. This particular concept had other advantages, particularly the cost, since the containment of volumes of water within the harbor is much easier to facilitate than withholding water above ground.

The form of the building is created by a linear sequence of display spaces, on the existing pier, with a wave-shaped roof, giving varies display size opportunities. Along the northern edge of this linear plan a series of gangways to the submerged oceanarium tanks are located. These tanks with their moving footways are designed, to give visitors the sensation of moving with the aquatic life inside the tank. The form of the building has a fluid maritime expression, so the architecture reflects the purpose at the same time as reflecting the overall theme of the Darling Harbor as a maritime place.

Externally the tanks contribute to the Maritime character of the Darling Harbor, covered by a fabric roof hung from masts and cables and floating alongside the pier, these are intended as a direct metaphor for the barges or sails moored to the wharf. The building is used to terminate the walk, along the eastern promenade of the Darling Harbor

It is partly for this reason that it is oriented perpendicular to the eastern edge, as well as to have the quality of a pier building. The rising roof forming a backdrop to Pyromount Bridge from the south accentuates this termination.

PLANNING

The planning emphasis of the aquarium is for visitor facility and enjoyment, which is created in a number of ways. Varies forms of display spaces are used, which provide elements of surprise and theatrical experience.

Facilities are included toward public attraction, such as unique underwater displays, theater and excursion groups, and waterfront restaurant and souvenir shop. The displays vary over a large scale and the specimens exist in number and habitat with minimal restriction. The operational sections of the aquarium are designed to effectively support the visitor and exhibition facilities through development of efficient maintenance and management operations.

MURRAY DARLING RIVER
1 Platypus
2 Murray Cod

MANGROVE HABITAT
3 Saltwater Crocodile

RIVERS OF THE FAR NORTH

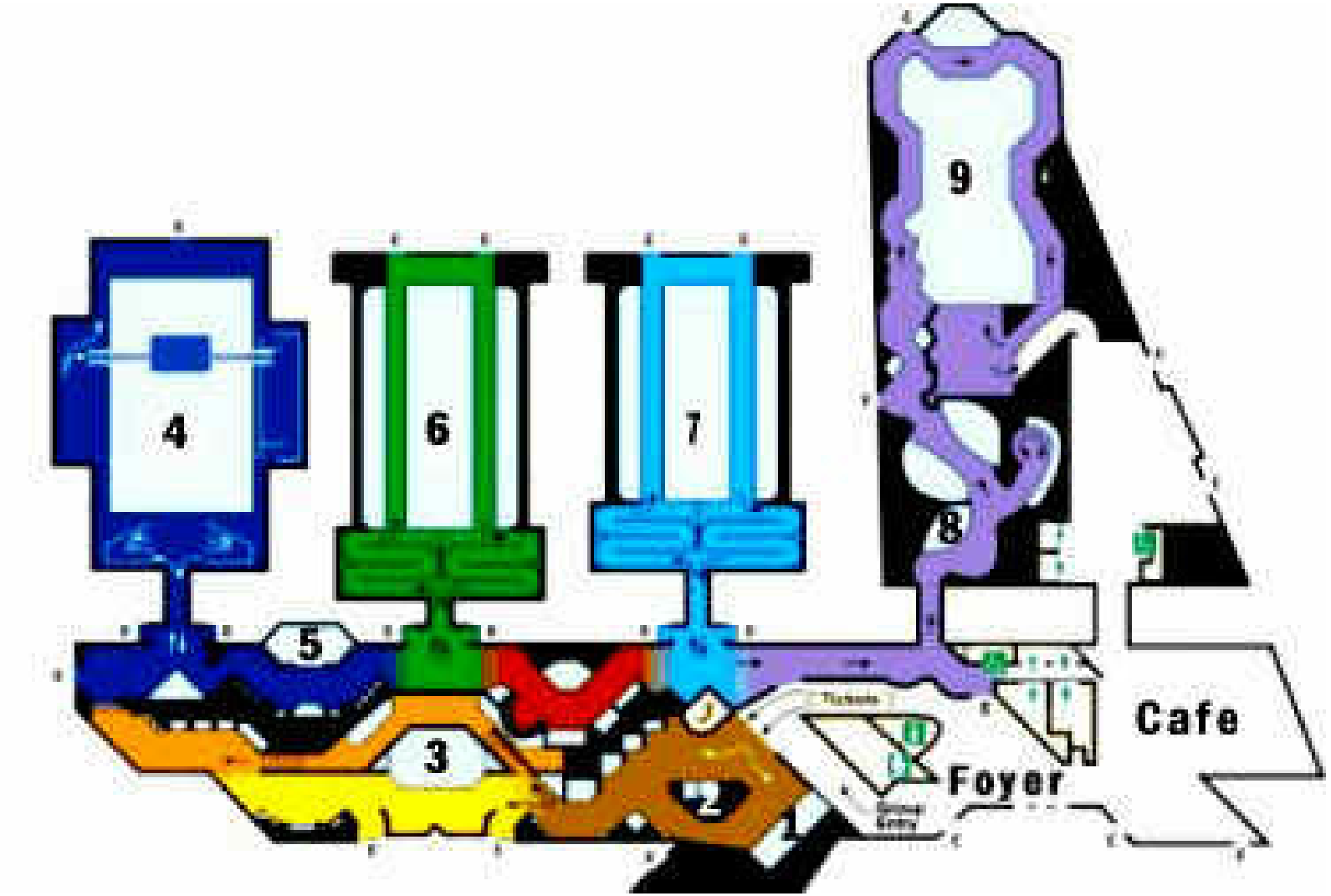
GREAT AUSTRALIAN BIGHT
4 Seal Sanctuary
5 Fairy Penguins

SYDNEY HARBOUR
6 Sydney Harbour Oceanarium

ROCKY SHORES

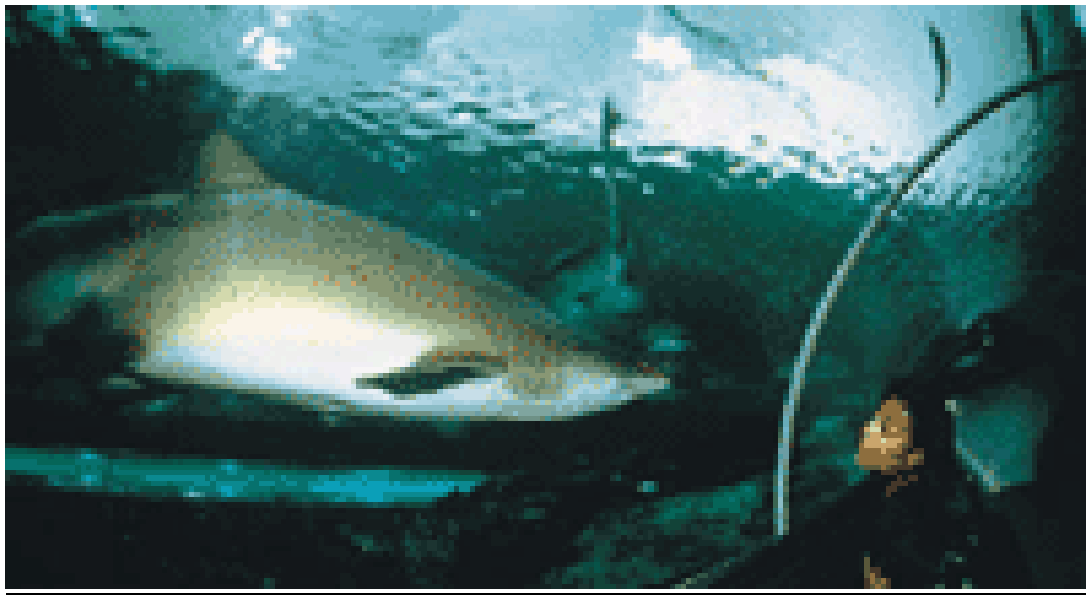
OPEN OCEAN
7 Open Ocean Oceanarium

GREAT BARRIER REEF
8 Touch Pool
9 Oceanarium


9
4
6
7
8
5
3
2
Cafe
Foyer

EXHIBITION

The exhibition components are designed in such a way, that they reinforce each other in a single spatial context. The exhibits are conceived to share a single space, from which daylight is either excluded or utilized and through which the visitor continue to move, changing their point of view while maintaining the same orientation. The exhibition is conceived on linear sequence of experiences. Although the visitors are left with a choice to go directly to the exhibit of their own liking, the majority of visitors are encouraged to follow a predetermined path, allowing a general thematic structure to guide their experience and allowing a build up of emotional involvement, climaxing in the tank. The visitor sequence was programmed, so as to consist of parallel journeys through various habitats. The progression is ordered but effortless; to make the visitor, feeling immersed, in the medium in which they are exploring.



STRUCTURAL DESIGN

THE MAIN BUILDING—The curved form of the roof is achieved with conventional metal sheeting supported by steel purlins. The infill walls were framed with back-to-back steel C- sections, and are clad externally with either corrugated steel or glazing and internally with either block work or plasterboard.

OCEANARIUMS—In the designing of the oceanariums, attention was given to the following:

1. Implication of the classification, certification and safety
2. Structural efficiency of the floating vessel
3. Stability and motions of the systems
4. Fabrication, launching, handling and mooring of the vessels.

MAINTENANCE CONSIDERATIONS.

The significant advantage of the design of the oceanariums was in their structural efficiency. The structural design uses the harbor water to act as the retaining force of the filtered water inside the tanks. The oceanariums are steel framed with a steel plate skin. Along the long sides were located 2.5mx2.5m saddle tanks, which were subdivided into individual smaller tanks. The access towers located at the north and the south ends of the oceanariums are made of steel framed and clad in fibrous cement. The lightweight roof of the oceanariums consists of tensioned PVC coated polyester fabric membrane spanning between cables, which in turn, are suspended from steel masts.

MAIN PIER BUILDING AND THE SUPPORT BUILDING

STRUCTURE—The main building was lightweight steel structure comprising frames at 7.2m spacing; steel columns cantilevered off existing pier slab; overall stability against wind resisted by portal action constructed within frames; the support building has a light weight steel structure comprising of frames at 7.2m spacing, steel columns are supported on concrete footings and the ground floor was cast concrete slab on ground.

EXTERNAL WALLS—Steel framed, corrugated, color bond sheeting vertical panels, 900 mm wide and of continuous lengths.

ROOF—Corrugated color bond steel sheeting, sprung curved and fixed to steel purlins supported on lightweight curved steel frames.

WINDOWS—Powder coated aluminum glazing sections support or steel frames at 900 centers.

WALL FINISHES—block work walls either painted or rendered and painted; painted plaster board on steel stud frames; wet are tiled to the ceiling.

FLOOR FINISHES—Ceramic tiles in the foyer, gift shop, restaurant and wet areas; carpets in the exhibition and administration areas; vinyl or concrete in the service and support areas.

OCEANARIUM:

STRUCTURE—Steel framed structure with steel plate skin at deck level and below water; saddle tanks 2.5mx2.5m located along the long sides of the oceanarium and concrete poured in situ used as further ballast.

EXTERNAL WALLS—Deck level and below clad in steel plate, above the deck level a steel frame clad in fibrous cement 900mm wide vertical panels.

ROOF—Tensioned PVC coated polyester fabric membrane supported on cables suspended from four steel masts.

FLOOR FINISHES—Rubberized non-slip painted finish and moving footway.

TARPOREWALA AQUARIUM.

Project	: Taraporewala Aquarium
Project Address	: Charni Road, Mumbai, India.
Client	: Shri & Shrimati Vicaji D.B. Taraporewala
Date of Commencement	: 9th May 1947
Date of Completion	: 27th May 1951
Actual Cost	: Rs. 8,90,904/-

Credit

The Aquarium owes its existence to the munificence of Mr.Vicaji D.B.Taraporewala, whose donation of Rs. 2 Lakhs enabled the fulfillment of a dream that was hanging since 1912.

Location

The aquarium is located on one of Mumbai's prestigious locale—The Marine Drive. It faces the sea on the other side of the Marine Drive Road.

Site and Environment

The site selected to construct the aquarium at the Queen's Necklace—Marine Drive could not have been more appropriate, as the Mumbai of yesterday was a fishing village and the site has a sea-face. The Govt. of erstwhile Mumbai State provided land to construct this educational and recreational center.

Aim

The aquarium opened for public in 1947. The ground floor (mainly occupied by the display area for public) with an area of 4260.8sq.m. Was designed with the view of around 800-900 no of visitors per day. Present day 2003 no. Of visitors is 4000-5000 in its 9hrs. Of working schedule 9am – 6pm.

Circulation

The 3 storied building has an aquarium and related offices on ground floor. First floor has an administration and research department. Second floor is occupied entirely by the library.

Public circulation path for the aquarium is in inverted U- form with entry on the right side and exit on the left side.

Service passage lines peripherally around the display tanks and remains visually and functionally independent.

Water circulation is by the CLOSED SYSTEM.

Non aquarium activities	1415.60sq.m.
Aquarium activities	2271.60sq.m
Area available for expansion	165.62sq.m

Structure and Materials

R.C.C. beam and column construction, galvanized pipes for pipelines, glass for aquarium tanks.

Foundations

The foundations of the aquarium rests on reinforced concrete piles, mainly of which have been driven to 30ft. deep so that the building may be claimed to be earthquake proof.

The building is three storied and 200(61ft) away from the sea wall. It is rectangular in form with it long axis running from west to east.

Details of expenditure for maintenance of aquarium as in 1994 are:

Building	Rs.5, 77,974.00
Water and aeration	Rs.1, 07,150.00
Electric installation	Rs. 74,079.00
Gas Connection	Rs. 3,700.00
Water barge	Rs. 80,000.00
Miniature exhibits	Rs. 6,000.00
Fridge, aquarium tanks, scientific equipments	Rs. 42,000.00
TOTAL	Rs. 8,90,904.00

Categories of Major Areas

GROUND FLOOR

Entrance Hall

Fountain at the further end of hall combines utility with aesthetic as water spurted up enters duct connected with general fresh water circulatory system and is deprived of noxious gases.

Conclusion

The entrance hall is utilized only as transition space from main section to miniature section and outside.

Although the fountain animates the atmosphere, there still is a 10^{th} of scope for an interior designer to create an underwater effect.

Administration

To the right of hall (south side) are

1) Curators office
2) Conditioning room
3) Staff room
4) Service corridor or a small chemical lab.

All specimens either for display or for study are kept in the conditioning tank for observation before introduction into main aquarium tanks. This tank/s is also called as quarantine tank wherein specimens are tested on.

Conclusion

Insufficient waiting area outside curator's office.
Conditioning room has ordinary polished Kotah tiles for flooring.

Miniature exhibition hall

Small fishes corals, worms; coelenterates are kept here in about 1-foot deep fish tanks, as these would be lost in large tanks. Also it has a display of shells, cones and other such items. These tanks are held in wooden partition 1m away from the wall for service purpose.

Main section

There are 18 tanks for marine/ salt-water specimens along the periphery which the 3 tanks in centers of hall display fresh water specimens. In all there are 66 tanks with glass frontage 1.1/4 inches thick. Capacity of each tank ranges from 1000-5000gallons. The tank interior is decorated so as to give an effect of natural environment. The tank seems to be literally framed and look like pictures framed in mosaic partitions. The exterior surface is cladded with marble tiles with timber railing preventing visitors from coming too close to the tanks. Display boards on top of each tank give information above contents of the tank. Ventilation of hall is by exhaust fans and there is consideration darkness in the hall so as to highlight the lighted tank inter-view.

First floor

It has been set aside for research administration purposes. North end has the marine biological lab. South end has the office of the Director of Fisheries and his staff.

There are 2 labs with a dozen research workers and up to date facilities like arrangement for supply of running sea and freshwater, ducts to ensure proper aeration, gas, paraffin baths and optical instruments and special tanks where specimens can be studied under controlled conditions.

Second floor

The library and offices have occupied it.

Conclusion

The first and second floors are now not in a working condition and are shut down temporarily for repairs.

Special features

Illumination

The tanks are illuminated by normal tube lights which are hung about 1’ to 1 ½’ above the water level. The sloping roof above has glass skylight to admit natural light. The skylights were originally tinted pale blue (no longer) to prevent excessive growth of algae in the tanks.

Aeration

Elaborate arrangements have been have been made to ensure a constant stream of air into all the tanks. The silvery jet of bubbles spiraling to the surface of the water from the bed of the tanks is compressed air released in each tank. Behind the main aquarium section is the pump/machinery room where pumps and compressors operate the circulatory aeration system. Entire machinery operates on electricity and once the main switch is on the water keeps changing day and night.

SERVICES:

Reserves

Below the room containing pumps and compressors are two water reserve tank. The seawater reservoir is 3.3m by 14.0m by 4.5m while the fresh water reservoir 3.3m by 14m by 4.5m

The reservoirs receive water from the filtration plant and from here the water is pumped continuously to the respective overhead tanks directly above the pump room. From here it is conducted to the exhibition tanks by gravitation. The piping used here is HDP (HIGH DENSITY POLYMER) type.

Service passage

The service passage behind the display tanks is about 1.2m higher than the public area. It is 1.5m wide with water channel along its one end taking out from tanks to the settling tank.

Conclusion

The service passage has ordinary polished Kotah tiles for flooring lacks non-skid floor finish.

Purification plant

The purification plant consists of the settling tank and the filtration plant. The filtration plant is a structure located in the open space on north side of the aquarium buildings. Both the seawater and the freshwater systems have separate underground concrete settling tanks and filtering units. The filters have filtering media of pebbles and sand of varying grades arranged in layers.

Water first enters the settling tanks and then passes into the filter beds. Then both seawater and fresh water flow into their respective subterranean reservoirs. From here water is pumped to overhead tanks and from there it flows to the display by the gravitation.

Seawater is brought to the aquarium from the sea just off the marine drive road. Earlier a barge was used for providing undiluted and unpolluted seawater from a pond far off from the shore at floor tide. Now water is directly pumped. Fresh water is received directly from the municipal water connection.

Water circulatory system

The circulatory system adopted for changing water in the display tanks is closed system. The same water is used over and again for a period of 1 month. After which new supply is taken. This helps to maintain the ph and chlorine level in the water and is also less tedious.

VITAL STATISTICS

Area of plot	4136.55sq.m.
Area occupied by garden	620.48sq.m
Total area	2895.60sq.m
F.S.I. permissible	1.33
Area permissible for construction	3860.74sq.m.

The existing structures are inclusive of aquarium and non-aquarium activities

Non aquarium activities

Annex bldg (inclusive of RDDF by ADF by statistics dept.	992.60sq.m
Canteen inclusive of accounts dept.	380.00sq.m
Garage	43.00sq.m
Total area of annexes building	1415.60sq.m

Aquarium activities

Taraporewala aquarium	2055.30sq.m
Filter tank	34.89sq.m
Fish food shed	9.84sq.m
Pump shed	12.92sq.m
Salt water settling tank	158.67sq.m
Total area of aquarium activities	2271.62sq.m

Area available for future expansion 165.62sq.m

SINGAPORE UNDERWATER WORLD

GENERAL INFORMATION

Date of opening	13th may 1991
Cost of development	$27 million
Land area	2.5 hectares
Location	Sentosa isle marine
Animal population	over 2,500 animals from more than 250 species
More recent development	$3.5 million 500sq.m. Changing exhibit hall
How to reach there	Sentosa bus service from world trade center bus terminal
Opening hour's	9.00a.m. To 9.00p.m. Daily

UNDERWATER WORLD SINGAPORE PVT. LIMITED
80 SILOSO ROAD
SENTOSA
SINGAPORE 098969

Underwater world Singapore is a state of the art leisure attraction showcasing the rich variety of marine life to be found around the region. Situated on Singapore's 'pleasure island' of Sentosa, it compliments the recreational activities available here. At underwater world Singapore, visitors are taken on a voyage to the bottom of the sea which begins at the sandy beaches and shallow rock pools at the waters edge. From here, they start their descent passing brightly colored corals and all kinds of exotic ocean dwellers along the way. Finally they come to a spectacular 83-meter long acrylic tunnel, home to a great shoal of fish, prowling predators and a host of other creatures that inhabit the ocean depths. In addition various exhibitions are on display at the changing exhibitions on display at the changing exhibition hall.

Besides opening visitor's eyes to the brilliance and diversity of undersea life, underwater world Singapore also plays an important role in education and marine conservation. School visits are actively supported, and a number of new educational programs are planned for every year. Underwater world Singapore has long been involved in the rescue and conservation of endangered turtle species, and later spearheaded a coral relocation project in the southern islands, which had been embarked for land reclamation and development.

It is also a tribute to the underwater world Singapore, that many fish living here, such as the black tipped sharks eagle rays and big belly seahorses, bred quite naturally-indicating how comfortable they are within their environment.

TURTLE POOL

Located outside the main entrance, the turtle pool provides a safe heaven for a number of highly endangered species, including the hawks bill turtle, loggerhead turtle, many of which have been rescued from illegal traders. Some of the green turtles here will be returned to the wild as part of the conservation process conducted with the Nan yang technological university. The turtle pool can be viewed both from above and below and from an underground observation chamber.

VERTICAL TRABE

This six meter deep cylindrical tank located facing the entrance, extends from the first floor to the basement below. Fish to look out for include the surgeonfish, identified by the scalpel-like blades at the base of its tail, parrotfish and diamond shaped triggerfish.

TOUCHPOOL

To the right of the entrance is the touch pool, where the visitors can handle marine creatures such as the smooth textured blue spotted stingrays and the much rougher feeling blind sharks. other interesting exhibits are the two horned cowfish, so called because they take in water to appear bigger when threatened, and the archerfish, which catch insects by shooting jets of water above the surface.

REEF FLAT

A little farther along to the left is the reef flat. Landscaped with the vibrant live corals typical of the kinds found in shallower waters, it contains a myriad rainbow-colored fish of all shapes and sizes. These include a number of angelfish, butterfly fish, and the skinny underwater razor fish, which swims vertically. A layer of protective mucus on the clownfish allows it to swim happily amongst the tentacles of the sea anemone, whose sting would kill any other fish.

CHANGING EXHIBIT HALL

DUGONG-MYTH AND LEGEND

Pacific island folklore tells us that offering sacrificial babies, born during a certain time in the lunar cycle, was one of the ways to appease the gods that bestowed bad luck. One younger mother, vowing never to be separated from her newborn and believing this to be true, jumped in to the sea with her baby, supposedly reappearing as a Dugong with a calf by her side.

Ancient mariners, mistaking the shape of be mermaids, often ran their ships, around whilst being lured by their sound and song.

BACKGROUND TO DUGONG CALF RESCUE

On arrival they suspected that the two animals, one fully matured female (deceased) and very much alive calf(approximately 6 months old) were a mother and calf pair. A post mortem carried out on site by UES veterinary confirmed that the mother had died approximately 5-6 hours before arrival and that she was still lactating. That was the first proof of the mother calf association.

Following consultations with other internationally recognized, experienced marine mammal people, they agreed that the chance for survival of this was not yet weaned. Calf was very slim. The decision to rescue and relocate the calf was made that evening.

MAJOR EXHIBITS FOUND AT THE UNDERWATER PARK SINGAPORE:

1. Giant octopus: the largest of its kind the giant octopus (octopus dofleini) are found in the northeastern and northwestern areas of the pacific ocean.
2. Seahorses
3. Electric eel- the most shocking fish in the world
4. Piranha- the most dangerous fresh water fish in the world, which have razor, sharp teeth that can slice the skin very easily.
5. Puffer fish- these gulp in water and puff up when threatened. Its liver, intestines and skin contain the most deadly poison in the world known as tetrad toxin. When eated, this can paralyze and kill a person in less than an hour.
6. Cave inhabitants and dangerous marine animals.

GREAT BARRIER REEF AQUARIUM

LOCATION

Townville, Queens land, Australia.
Wonderland has a picturesque sight behind an old wharf on the Ross creek.

YEAR OF COMPLETION

JUNE 1997

CONCEPTS AND CONSIDERATION

The main objective of this aquarium was to create a living coral reef in a land based facility to enable people at low cost and in comfortable surroundings, to see and appreciate the wonders of the great barrier reef, thereby gaining community support for its management and conservation.

The principle goal is to provide for the protection, wise use, understanding of the great barrier reef in perpetually through the development of the great barrier reef marine park.

MAJOR EXHIBITS

Coral display

Here coral polyps are displayed. One can pick up coral skeletons displayed.

Theatrette

This shows a colorful introduction lasting for fifteen minutes of the great barrier reef.

Coral reef tank

This holds over 2.5 million litres of sea water. It is 38 m. long and 17m. wide. Nature has been duplicated as closely as possible to keep the delicate corals alive. This tank is open to natural sunlight.

Waves are created by a machine located behind the water tank wall. A current is made by a recirculation of water in the tanks via big pipes visible from the windows.

Touch pools and quick silver discovery room.

The discovery room displays creastures that can be touched and studied closely.

Sea snake displays

This variety displays a variety of venomous sea-snakes found in the region.

Circulation

The public enters the main hall where they are guided

SITE SELECTION

Criteria for selecting a site for the oceanarium

Present availability of such a complex

Need for public awareness

Likelihood of pollution

- Industrial pollution
- Domestic pollution
- Thermal pollution

Accessibility of the site

Climatic condition

Water supply

- Sea water
- Fresh water

Scope of future expansion

Tourist flow

- International
- National

Local population and flow

Supply of electricity

- Phase 1
- Phase 3

Availability of fishes and resources

Sewage disposal

Future proposal effecting the size and project

Gradient of the cost line

Economic sustenance of the project

.

Selecting a site for the project was a big concern. Many were of the opinion that it is of no problems since a project like the oceanarium can be sited any here along the coastline.

I managed to procure a possible site at Alibaug. Though I had selected two sites, the basic topography and the aspects were positive or the negative differ to a large extend with no common platform between them, hence I had to decide according to my personal reasoning as to which site would be more practically selected. Following are the criteria of the two sites and the reason why I picked Alibaig.

SINDHUDURG

Positive aspects:

2. The first criteria are the presence of natural coral reef in the region of Malvan.
3. The waters of the Malvan beach have been reported to be the richest in the flora and fauna as per the report could forth by the national institute of oceanography, Goa.
4. The considered Chiwla beach formed a protected bay with the Arabian Sea and a river.
5. The waters a free from any industrial wastes and other pollution with high clarity.
6. The government has passed the proposal of developing the adjacent bay into a marine park.
7. Further suggestions have been made to build an aquarium.
8. The government has announced Sindhudurg as a tourist paradise for years to come.

Negative aspects

1. There is a very thin stream of incoming tourists at Sindhudurg, which constitutes basically the localities and the few travelers from with in the state ere likely to visit their native place and relatives in the vacations and festive seasons.
2. The location s not promising enough to attract tourists through out the month.
3. There is a great possibility that the facilities provided would be underused.
4. The income group of the localities is not large enough SP as to pay occasional visits to the oceanarium since the tickets have high rates.
5. Since a project on a scale as large as an oceanarium seeks fact funds for the oceanarium and is a know profit project hence due to the lack of tourists/visitors it might lead to heavy loses by means of maintenance.

ALIBAUG

The site selected is Alibaug.
The waters in Alibaug are highly polluted with domestic wastes a thermal wastes.
As one moves away into the smaller islands located on the inlands the pollution reduces to a considerable extend.
The site selected is Alibaug on the western coast. The site is losing as well as aloof from the hustle and buzzle of city life. The site is located along the calm and scenic coastline of Alibaug. The site is on a huge no development zone. Due to the selected site the oceanarium will ensure the tourist flow of even this zone. The urban grain of the site comprises of small bungalow plots. There are small tourists resorts spreading theor lush green lawns with shady mango and palm trees. There are also fish dry yards. One takes instamnd liking to the pure, clean air and the peacfull environment of the island away from the hassles of the rowded citylife.
These strategically located sites will not only attract national but also international tourists.
Depending upon the ratios of the ites and builtup areas from the case studies the site sleted spreads over an area of hectares.

Topography
The site is rocky at the edges near the waters.

Climate.
The rainfall is above average. The maximum temperature is 33 degree Celsius and the minimum temperature being 20 degree Celsius. Humidity is high.

GENERAL CIRCULATIONS THROUGH THE COMPLEX

Plenty of scope for the changes of levels and thus heightening of visitor experience mountain stream exhibit is high, well lit and prominent with visitors dropping lower and lower into the final dramatic shark exhibit. Rising up by escalators from the concourse level to the mountain stream exhibit is an exciting experience in its own way.
Separate school entrance is conveniently located close to the coach set down and collection point away from the main public entrance.

There are totally four entrances into the site, one being the pedestrian entry, two being vehicular and the third serving as both coach entry and service entry. There is also a hovercraft terminal provided from where a person is brought to the main entrance by a small tram journey thus giving them the excitement of entering a world of fantasy and fun. From the pedestrian entry the people move via escalators to the main entrance and ticket counters. The escalator moves upward through a beautifully landscaped site, water being the principal subject in the landscape design. From the ticketing office, the visitor is guided to the building through a bridge across water and glazing. Once into the main building the visitor is greeted by an introductionary exhibit in thebn form of a semi-dome and finds himself totally engulfed by water and fishes. The main concourse then opens in front of him as a vast multilevel circular hall. Here the vsitor is left with the chance of to visit the aqua museum and know about the origin, history and life of the fishes, or to visit the IMAX Theater and visualize an entire expedition from Th e surface to the bottom of the sea. The main concourse is located such that the best views outside are framed from various points in the building. One can staere out of the main concourse and see the dolphins leaping far off in the dolphinarium thus making them seem free in the ocean. This visual continuity of the water in the dolphinarium forms the focal point of the concourse. The cafeteria maximizes on these vividly interesting views in all the directions. The central concourse is experienced as a very imaginative wildly painted, and warmly decorated space. The cental part has suspensions of false life size replicas of whale skeletons and other shimmering graphic fishes. The walls are furnished in wavy surface textures with mosaic thus depicting the oceans at certain points.
The concourse and the escalator route, upto the start of the exhibit are elevated, maximizing on the best views. As one goes to the main fresh water exhibit level via a capsule lift, he glances outside at the tiny vivid picnic areas stretching before the shoreline in the southern side. The main theme of the exhibition is to take the visitor from the highest levels, from the origin of the streams to the surface of the water. Backup, maintenance, plant deliveries and other surface areas are out of the public view. The visitor is enveloped by the reality and the magnificence of the mountains streams exhibits. Visitors are encouraged to move through the exhibit via ramps and thus actually exhibit the ups and downs. This is followed by a formal display of the aquatic life in fresh water ecosystems. A break in the exhibition is provided by a connecting structure between the main entrance buildings and d the oceanarium building. Snack bars and toilets are provided at convenient locations along the flow. This point also gives the visitor an escape into the lower water plazas and pools. He can resume his journey after a short rest. The journey into the oceans starts from the variety of the habitats from the different oceans of the world and finally ends up in a deep shark tunnel. From here onwards, the exhibition takes a lighter shade, and the visitor moves forward to conclude his journey moving through the calming exhibits of the touch pools which serve as major attractions for the kids and the photo taking tanks, these attracting huge curious crowds. There is a larger time factor involved here and hence

are located at the end of the route in order to avoid the slowing of the visitors before. Once outside the visitor finds himself in the water plaza. This being the central plaza being the main meeting places. From the plaza the visitor moves according to his choice into the animal pools, the dolphinarium, to the restaurant or back to the main building. The restaurant is designed as a highly desired peaceful gateway at the edge of the shore, secluded at gazing out into the vast openness of the sea. The animal pools are incorporated into the landscape to add to the fun and the surprise element of the in the route. The dolphinarium is accesed via a bridge the seating is such that the visitor feels the dolphins are performing in the open sea. Further a more interesting journey through the conveyor beltjourney on top of the IMAX dome. The visitor in thew end is destined to come back into the main concourse where he can go through the gift and souvenoiors shop and finally retire into the picnic area or out into the parking zone. The administrative research and the educational block are sited separately to the north of the site to benefit from the good sun and to avoid obstructions in the public movement.

The new major public square is protected from the cold northerly winds.
A new public viewing terrace leaves the foreshore undisturbed and enhanced.
Design strategy for the vertical planning of the building.
Maximize on existing site gradients to separate the main entrance and the aquarium external queing from the visitor exit flows and thereby avoiding congestion.
Elevate comncourse on maximum on best views outside.
Vertically plan exhibit spaces to minimize costly surplus space locate lecture space at the same level as ther deep reef function area to provide added flexibility for the revenue generating functions.

Reinforce the landmark form by locating the mountain stream exhibit at the highest point and lighting it with a striking and yet functional glazed roof.

Design and criteria
Concepts and considerations

2. Display tanks should provide variety and lead to the public.
3. Shape of the tank better if more display footage.
4. In a good design for efficient operation and adequate space for the public will have a percentage of 60% work area inclusive of display tanks? 40% public area is provided.

5. Backside should be totally out of site.

Individual aspects of various facilities.

1. Public area

Provide surprises, alcoves, cut outs a visitor turns right hence such a design flow pattern. It is important that the exit also is convenient for the public and should not open into an area, which will confuse the visitor of his orientation and should also not open into the rear service area.

7. Work and service area.

Work area floor should be 3 inches higher than the public area floor. Therefore display level tankers
Are at the eye level of the visitor.
Natural light in this aquarium should be minimum to avoid algal growth in the tank.

- A service passage of minimum 1.8 m. wide is located behind the display tanks.
- No staircase must open into the passage or any other obstacles.
- Non-skid floor finish with floor drains.
- Staircase placed conveniently from work area to public area. The floor of service passage is higher so that the tops of the tanks are about waist high for the staff.
- Space below thwe passage can be used to house drainpipes etc. if the floor is made of removable section supported on joints.
- This service must be easily accessible from the administration office and outside of the building.
- In the vicinity must be the food preparation and the washing facility.
- Work area must be compact.
- Quarantine tanks and holding tanks with its own recirculatory system and total holding capacity should be equal to $1/3^{rd}$ of the display volume should be provided.
- In the operation area a small storage must be provided for tools and chemicals.
- This work area must be located convenient to live exhibits and personal like biologist and aquarists and also close to food preparation room and rolling access to public area and administration offices.

8. Loading dock: the principle terms being received are fish foods specimens and occasional material for tanks. Thus the facilities to which these will be delivered are located centrally for best access to all displays.

9. Food preparation: the food for exhibits even include live food, cut fish, meat dry foods. Therefore it should have enough space for preparation for a number of fishes in small batches. A refrigerator or freezer is required.
10. Quarantine facilities (shipping and receiving area): the room is equipped with a number of moderate size tanks and water supply in common width but separate from supply to display tanks. Holding tanks should also be provided.
11. Pump room: including water handling equipment heat exchanges, sterilization and pumps storage reservoirs are located below this pump room from where it is fed to overhead water tanks
12. Storage: for exhibit material space pumps, glass, small display tanks. Important requirements should be satisfied and the project should be spacious.
13. Utilities: in this area are located the building heating and cooling equipments electrical panels water softeners for domestic supply etc.
14. Crew room: for crew to have a break with a small pantry and should adjoin a shower and toilet area.
15. Office of the curator an aquarists will be a small lab.
16. shops for preparation and repair of exhibits.

NOTES

1. one could have different levels in an aquarium with an elevator and a food preparation room in every level
2. average depth from front to rear of display tankers is 1.8m. but may vary.
3. the service core should be concentrated in a block near the loading dock.
4. minimum sizes.
    - food preparation 20m. square
    - freezer and cool room (if these are not provided the food preparation must be enlarged for upright refrigerator and freezer)-10sq.m.
    - shipping and receiving 12 sq,m.
    - pump room 45 sq,m.
    - utilities 16 sq,m.
    - storage 20 sq,m.
    - office lab 15 sq,m.

- shop 15 sq,m.
- holding tankers 20 sq,m.

the specific items for micro level design include:

Service passage
The floor of the service passage should be much higher than the public hall, so that the tops of the tanks are about waist high for the staff attending them. The floor should be of removable sections supported on joists (all preferably of material unaffected by water) and the space beneath should house pipes drains etc.
If the floor is placed too low the staff has to climb up to carry out normal servicing. If it is placed too high, near the level of the top of the tanks, there is a danger of harmful materials, utensils or even the members of the staff to find their way into the water.
The service passage should be easily accessible from the administrative offices and the poutside of the building. One aquarium of my acquaintance was originally constructed without any door to the service passage, the only access being by way of narrow spiral staircase from the basement.
Somewher5e in the vicinity there must be working space for the preparation of food and other service tasks, as well as washing facilities.

The tanks
In most aquariums there are the most striking examples of the dead hand of tradition. In early days they were built with slabs of slate, a non-tractable material that forced a rectangular shape to the designer. Today we use reinforced concrete, but for some amazing reasons the rectangular shape is nearly always retained. The curator is then given the difficult task of trying to hide the corner of every tank, so that his choice of composition is disastrously reduced. The reason why the corners have to be hidden is that they destroy any illusion of depth or space. They define the limit of the tank and reveal the fishes as creatures trapped in a small box.
But why have corners at all? Ferro concrete tanks can be made in any shape, and by far the best efficient is curving the sides so that it merges into the sides. The base of the tank, similarly, should be curved so as to pass to the bottom without a joint. The back of the tank is then rendered smoothly with blue or green and the floor rendered with some rock or sand-colored cement, the two shading into each other to give an impression of distance. The

limitations are then removed, and one has the feeling of looking through a window into the sea or lake. Against this background any arrangement of tank furniture becomes possible.

Overflows

Tanks on circulation need an overflow, but unsightly round pipe mouths have spoiled the beauty of many aquariums. In preference to pipes, which restrict the circulation unless they are very much larger than the feed pipes? I would recommend the wear level; a channel is constructed on the back of the trunk to carry the water into the drain leading to the filters(or waste as the case must be). The water flows thinly and evenly over this weir and the most that can be seen through the glass is a narrow slit at the surface. This is a particularly useful method to improve existing tanks.

With new construction a wide vertical pipe, its mouth at surface level, can be built into the wall of the tank or among rockwork, where it will be invisible. If the tanks have a curved interior but a straight back ther will be a thick corner into which the overflows can be built. In all cases provision should be made for a plastic screen to prevent fishes etc. from going out through the overflows.

Every tank also should have a waste pipe to facilitate quick emptying. Ideally, this should have a large flat cover fitting snugly into a recess in the floor of the tank, so that nothing can creep into it. The pipe should be opened and closed by a valve externally.

Glass

Returning to the aquarium proper, there seems sometimes to be misunderstanding when the thickness of the glass in the aquarium is computed. It is often forgotten that water pressure increases with depth and that the pressure is the same in all directions. The other dimensions of the tank are of small importance, and so far as the length is concerned only normal calculation of stress is to be made.

For sheets of polished glass plate glass upto six feet in length should be used. I find that a useful thumb rule is to allow ¼ inch, or 6mm. Thickness of glass for each 12 inches or thirty-cm. of depth. Thus water 24 inches deep requires ½ inch thickness of glass, 36 inches require ¾ inch and so on. But to give an extra safety margin for the public the ½ inch should be increased to 5/8 inch, the 3/4th to one inch. Beyond a length of six feet a bending factor demands a further increase in thickness. I do not know whether anyone has experimented with curved, reflection less panels as aquarium windows, but they might be worth trying. Theoretically they should be very strong behaving like arches.

Piping

All piping should be non-corrosive and made of chemically inert materials.
Rigid polyvinyl chloride with a smooth interior can be used. Non-weldable pipes so that getting a hold ane forming colonies are very low.
Piping should be non-corrosive but metal pipes could be used to serve cetaceans, seals penguins and reptiles but these are expensive due to the replacements required due to corrosion, se cement lined pipes. Even lead and stainless steel pipes which are considered safe must be avoided. Vulcanite, ebonite, pvc used cement concrete is safer after proper curing. Fiberglass is also used. Pumps and valves must be lined. Cement lined galvanized iron pipes are used in fresh water. Copper is totally banned; water circulation is delivered under pressure. First pumped to a height and fed to the display tanks by gravity. Th9is piping could be under the floor of the service area, or neatly stored under the drainage gully with just a narrow feed pipe in each tank. The feed pipe should come in through the tank bottom so that the water enters at the bottom and then overflows at the top eliminating the layer of dead water ensuring the oxygenation and encouraging the species to occupy the whole tank.
In salt water section ideal to have water from closed circulation brought to each tank and these can live up with the waste water pipes so that by the turn of a valve the correct water can be introduced by closing one and opening other, the waste can be emptied away or the tank can also be flushed at the same instance. Cover over the opening of the pipes should be finely perforated to let the water through. Sharp turns are allowable in metal pipes but are unacceptable in plastic or in fiberglass. Also avoid short twins when large dimensions are required. External piping should not be embedded in loose soil. Airliners should serve all the exhibits holding tanks. The air must be free from oil and carbon dioxide. The air is used to operate the lift pumps, standby power generators. None of the electrical installations should be embedded in concrete.

Pumps

The pumps should be of the air turn types. They are bendable and long lived. The efficiency is obtained by minimizing the bubble size. Compression is used.

Circulation

Closed system-closed circulation system is proffered as water stored in reservoirs can be conditioned to perfection.
Open system-no control over the calves water equally contains cloudiness noticed even when the settling tanks are in use.

Reserve water-some of the aquarists recommend that the water hold in the reservoir of the display tanks should be slightly more.
In reality very few reservoirs hold so much water, since in the case of disease etc. it may be reamed to dump way all the stored water therefore becoming impossible to avoid heavy animal losses. This reserve water is used mostly for routine replacement. Its quality may alter.

Freedom to be unencumbered by domineering authority and chart ones own course has been identified as a basic human need. To provide for exercise of the senses and to satisfy a need to ask, answer, formulate and analyze designers can enrich projects with fascinating details and provide surprises an unanticipated opening to view a bubbling pool or other discovered feature set in a hidden place.
Variety provides excitement and stimulation. It combats boredom and keeps faculties alert yet its over abundance is distressing.
Any man-made unit should be capable of invoking an emotional image whose influence could cause one to label it peaceful, awesome, exciting etc.
Line forms, textures, colours are important in providing emotional effects. The potential inherent in lines and forms are as follows: -

a. Straight lines are bold and domineering. They move the eye peacefully.
b. Horizontal forms are peaceful, calm and at rest since they lie comfortably on the ground at harmony with gravity.
c. 90 degree vertical lines possess a dynamic quality as they move the eye upward, the more accentuated the form, the more peaceful the movement and hence the greater the uplifting sensation of the soaring.
d. Diagonal and zigzagging lines are active and spirited, for there is lots of erratic moment in many directions.
e. Curved and undulating lines are not as dynamic as zigzags. Being slow and meandering they are inclined to be gentle and tranquil. But if the curve changes direction rapidly it can produce an animated or gracefully spirited feeling.
f. Similarly:
   Pronounced rough structures are bold and domineering like straight lines and in the extreme cases ponderous and primitive.
g. Colours also affect the visual sense in many ways and appeals to the most primary instincts.
h. Bright and high value colours are gay, lively and spirited.

i. Deep hues are sober and mellow.
j. Colors, toning down the potentially hectic effect in many unrelated hues.
k. Neutral recede to the background and are therefore useful in separating clashing

Every material object- farce, shrub water body exhibits landform, texture and color. It is through these elements that all ordinary things have aesthetical potential.

Effect of dominance
An important aspect is that the aesthetical elements are never experienced alone but in relationship with each other. It is important that 6the designer must contend with the qualities of all objects from every viewpoint as one might move about.
One might ask, what happens when through creative actions most object with in visual range are made to exhibit similar characteristics.
They infect contribute and add up to the provision of an exhilarating atmosphere e.g. bright cheerful colours on sign boards, sun umbrellas, fine textures in the paintings, sprightly dappled areas of light and dark provided by grill work, water fountains etc.
Visual focus is never static since the eye continually swings about bringing new objects into view.

Enclosure also affects the person contained within it
There are being mainly three kinds of enclosures-
1. Static enclosure- immobile
2. Linear enclosure- elongated volume that, moves in a definite direction with rear an front ends open. Thus compels the person within to move in the same way- this type is not conducive to invert oriented activities.
3. Free enclosure- it is a meandered volume, which allows movements of the eye of any number of directions. It is suited to unregimented activities where individual choice is being encouraged. It is free flowing.

It is important to realize that outer environment is as three-dimensional as indoors. Because a prime purpose of outdoor area design is not simply to device 2d round patterns but to create 3d volumes so that the aesthetic and functional advantages of enclosures may be gained.
Design must also be suited to personality of the user sends he is required to identified with it and at the same time suited to personality of the function and human scale.

It is important that the designer is aware of the essential creative process. He must place functional areas in appropriate spaces, which exists on the site. If such enclosures are vaguely designed, the designer has to reinforce the structures that their experience producing potential may be realized. Where the desired type and form do not exists, is required to create from scratch spaces to serve functions placed with in them.

As a focus for design concerned administrative procedures are considered essential into the working efficiency of the recreation complex. In the operation of complicated special use areas like a sea world and zoos where each administrator has his ideas about how he owns his complex to run. If the manager considers it most efficient to address his maintenance timetable to those hours when the public is not allowed on the grounds, the designer can opt for drives apart from pedestrian ways.

While beauty is in the eye of the beholder, order and variety are psychological aspect, which are common to all beholders.

LIST OF CASE STUDIES

DETAILED--

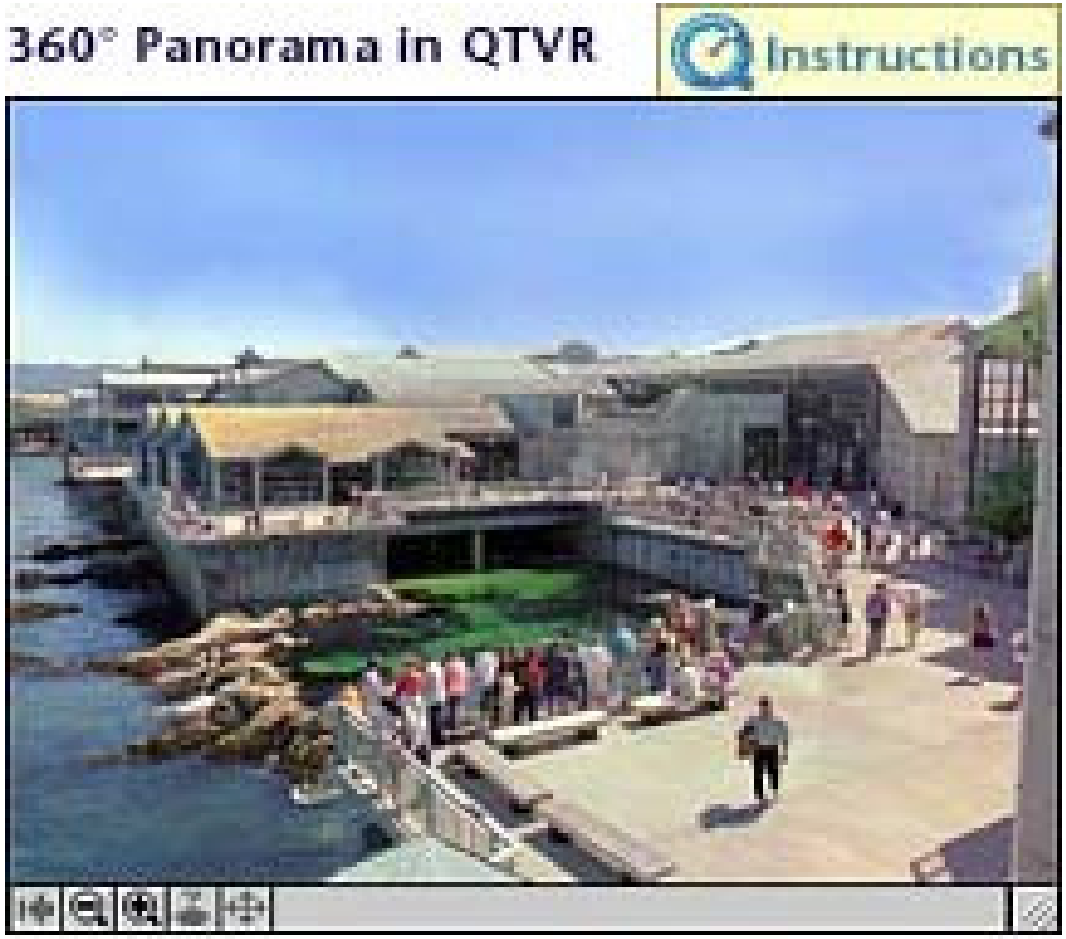
10) Taraporewalla Aquarium, Mumbai.
11) Tokyo Sea Life Park, Japan.
12) Florida Aquarium, Tampa.
13) Sydney Aquarium.
14) National Aquarium, Baltimore.
15) Great Barrier Reef Aquarium, Australia.
16) Marine Mammal Pavilion, Baltimore.
17) Imax Theatre Portville, Spain.

18) Berlin Aquarium, West Germany.

FOLLOW UP CASE STUDIES—

10) Sea World Florida, Orlando.
11) Sea Life Center, Birmingham.
12) Ibaraki Nature Museum, Japan.
13) Oceans Pavilion, Portugal.
14) Ocean Park, Hong Kong.
15) Singapore Underwater world.
16) Underwater Observatory Marine Park, Israel.
17) Vancouver Aquarium, Canada.
18) Monterey Bay Aquarium, California.

MONTEREY BAY AQUARIUM, CALIFORNIA



159.

The hidden soul if the Monterey bay is likely to remain a sweet mystery, but some of its stirrings is slowly becoming intelligible to scuba-diving marine biologists. Now there is a n aquarium at the edge of the sea which displays the secrets of its deep to the rest of us. They are awesome indeed. Fish marine mammals and birds tend to go where they can

find the best nourishment, and Monterey bay- 25.5 miles long and stretching 40 miles into the ocean- is rich in the tiny organisms that start the food chain. A number of circumstances evolving over a millions of years have brought this about. Among the most known of occurs the existence out in the bay of a great fissure on the ocean floor found to be deeper than the Grand Canyon. In late April through august, winds create currents that draw nutrient-saturated cold water from this depth to the surface. Keeping the food chain fresh and attracting an abundant and extraordinary variety of marine life. Consequently the shore became the site of the Hopkins Marine Station, an educational and research facility at the Stanford University. By happy circumstances daughters and son in law of inventor David Packard, the billionaire co-founder of Hewlett-Packard and marine biologists who have been associated with the Hopkins. An aquarium devoted to the marine life of the bay was their idea. When they proposed it to David and his wife Lucile, the parents responded by contributing $40 million to plan and construct the facility.
The young Packard trio Julie, and her sister and brother in law, Nancy and Robin Burnett, actually had two ideas. The second was to plan an and reconstruct the abandoned Hoyden Cannery next door to the marine station as the envelope for the proposed aquarium. The most westerly, sardine processing plant on the city's famous cannery row. In the early 70's it became defunct like the others the last of the old canneries to be sold to use as a warehouse by Hopkins. The Packard family decided to save at least one of the canneries by means of a stunning metamorphosis. The old Hoyden plant was a bout to display beautiful fishes instead of tanning edible other ones.

The first architect appointed by the Packard's was Linda Rhodes, now the executive director of the Monterey Bay Aquarium Foundation. She had even recently started her own firm by leaving the Esherick. Homsey Dodge and Davis. Soon joined by her former colleagues, she began to collaborate directly Charles Davis, principle in charge of the aquarium. After preliminary examination, Rhodes and davis brought the bad news to the Packards that the cannery was far too gone to be saved. Everyone agreed that the thing to do was to tear down the old structure and build a new one, as much like it in appearance at least. The factory like large lofts easily accommodate the large fish tanks, laboratories, classrooms and other facilities technical backup spaces and vast mechanical equipment in the aquarium.

But the interior displays and their envelope don't work quite work together. Movement through the exhibits seems random and unstructured architect Rhodes and Davis, however did not want a tightly ordered circulation system neither do the Packards. The contents of the tanks are so amazing that one hardly notices the roundabout routes anyway or even architectural space or structure as such. An attitude the design deliberately encourages. Outside on the terraces on stare into the tidal basin peers at the seals perched in the nearby rocks. Or watches sea birds diving into the offshore kelp forests. Here however the architecture is strong pure and looks and feels right in the bay. Would an aquarium designed from the beginning be the same?

160.

BERLIN ZOO AQUARIUM

The three important requirements influenced the planning and design of the new aquarium:

- All the enclosures were to be constructed so that the species could be shown in surroundings, which would reflect their natural environments. By providing this kind of a display it was hoped that the visitors would have the chance to observe at least some of the animals natural behavioral patterns.
- As much space as possible was to be set aside as quarantine units, tanks for the breeding and rearing of animals both for food and for display, and as areas for the cultivation of plants.
- All the outdated and cumbersome techniques installed in 1913 was to be replaced with modern and efficient systems, and the staff was to be given safer and more convenient working conditions.

160.

Three main building contains smaller fish tanks on the ground floor, the crocodile hall and the terrarium on the first floor and the insect and amphibian

sections on the second floor. Ramps for prams and wheelchairs have to be built at the entrance within the zoo and a lift, situated between the eastern extension and the main building, takes visitors from the ground to the first floor. The lift also descends to the basement for the use of staff. Most of the equipment needed for maintaining the many exhibits is situated in the basement.

161.

Overall heating in the eastern extension is supplied by pumping warm water through plastic radiators which are connected to copper pipelines; pipes situated directly over the tanks are made of V4A steel. The temperature is controlled by a special centrally controlled system in the basement. Fresh air can be blown under the glass roof to prevent overheating in the hot weather.

During winter months and on rainy days another 1000 volts mercury lamp over each landscaped exhibit provides the light need for plant growth. Each of the display tank is connected to its own reserve tank in the basement, and each is supplied by a four chambered graded filter.
A border 0-450cm wide and containing soil to a plinth of 150-220 surrounds the back and sides of each enclosure, slightly above the waters edge, and is planted with an abundance of foliage appropriate to the geography.
On the first floor of the eastern extension, above the quarantine unit and a section of the public hallways are the three staff flats. Two greenhouses, for the cultivation of plants for use in the aquarium section and terrarium as well as of wheat seeds and young oak trees for the insect section are situated centrally above the public hallway.

162.

CONCLUSION

The planning and building of the public aquarium at the Berlin zoo was not influenced only by functional but also by aesthetic considerations. Although in many places the public areas have been made smaller to allow for more off exhibit space, all attempts have been made to assure that these areas are comfortable and pleasing to the eyes

through the use in the main building; the northern staircase is decorated with majolica animal motifs which also serve as signs pointing ton the various parts of the aquarium. The exterior of the building is based in appearance on the pictures of the 1913 façade.
It is hoped that the combination of the old and the new has resulted in an aquarium which reflects modern requirements for the care and breeding of animal species while at the same time providing the public with an interesting and varied experience.

163.

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27) Monterey Bay Aquarium, California.

DESIGN - PROGRAM FOR THE AQUAPOLIS **JOE PAYYAPILLY**

ACCESS TO THE SITE --- by road from Mumbai via Panvel.
Vehicular parking- private vehicles 60 cars and 50 bikes
Parking for buses/coaches 7 buses
Vehicular parking for staff inclusive
Security booth

ACCESS TO THE SITE --- by sea from *Gateway of India,* Mumbai.
Jetty for the boats considering Hydrographic levels.
Security booth

1) MAIN BUILDING

Ticketing counters-current booking-2 nos.	
Small registration office	30 sq.m
Waiting lobby with reception	700sq.m
Baggage deposit area	90 sq.m
Gift and souvenirs	150 sq.m
Toilets for gents	
Toilets for ladies	

Telephone booths and water coolers are located at convenient and easily locatable areas
Information cells inquiry

2) AQUA MUSEUM

Office space for Curator 1 no.	And Asst. curator 3 nos.	80 sq.m
Pantry		15sq.m
Ocean Plants Display		575sq.m
Miniature displays		70sq.m

Exhibition galleries

a) small size tanks	1250 sq.m
b) medium size tanks	1250 sq.m
c) large size tanks	1250 sq.m
Touch pools	100 sq.m
Coral reef gallery	250 sq.m

3) SERVICE AREAS

Back up spaces for tanks as and where required	
Total Integrated Filtration Solution System on each floor	
Overhead tank	
Underground Reservoir tank	
AC plant room	120 sq.m
Generator room	150 sq.m
Pump intake room	35sq.m
Electrical transformer and control room	200 sq.m
Effluent drainage treatment plant and discharge	140sq.m
Toilets and wash	
Storage For materials for decorations and feeding areas for the tanks	80sq.m

4) CURATORIAL SPACES

Pathological lab—2 nos.	90sq.m
Quarantine tanks or Conditioning tanks—3nos.	80 sq.m
Seminar Room	275 sq.m
Curatorial work station	60 sq.m
Toilets for gents	
Toilets for ladies	
Water test lab	20sq.m
Research Room 2nos.	60 sq.m
Lecture Room	275 sq.m
Office Space for Aquarists 2 nos. ,Biologists 2 nos.&Medical supervisors 5 nos.	
Library	250sq.m

Storage	50sq.m
Record Room	60sq.m
Pantry as and where required	
Special Research Cell	550sq.m
Chemical Lab	70sq.m

5) DOLPHINARIUM

Main entertainment pool	1000 sq.m
Quarantine tank for the dolphins	
Sea pool (wave cove)	
Amphitheaterical seating	

6) RESTAURANT

Seating capacity 100 indoor and 40 outdoor	360 sq.m
Kitchen (veg and non-veg.)	40 sq.m
Food storage	80 sq.m
Staff office	25 sq.m
Change / locker room	10 sq.m
Toilets male / female	15 sq.m
Waste disposal unit (dry and wet)	60sq.m

7) ADMINISTRATIVE BLOCK

Officw space for Director 1 nos. and Executive 2 nos.	100sq.m Conference room
375 sq.m	
Board Office	60 sq.m
General office Accountant 1 nos	60sq.m
Office Space for General manager 1 nos.	60 sq.m
Chief engineer 1 nos.	
Asst. engineers 1 nos.	
Staff dining area and restroom	360sq.m
Pantry	15sq.m

Storeroom for records 2nos.	25sq.m
Gents toilet	
Ladies toilet	
Assistants 6 nos.	
Store room and Workshop for fabrication	150 sq.m
Gents non technical Staff toilet	20 sq.m
Ladies non technical staff toilet	20sq.m
Divers room	80sq.m
Common restroom for non technical staff with dining space	50sq.m
9) OMNIMAX SOLIDO DOME THEATER	
Administrative office	60 sq.m
Pantry	15sq.m
Theatre seating capacity for 500	1025 sq.m
Projection room and store	150 sq.m
Viewing gallery surrounding the theater	100 sq.m

Design to be followed due consideration of the aged and the disabled too.